AD-A070 587 VETERANS ADMINISTRATION WASHINGTON DC DEPT OF MEDICI--ETC F/G 5/2
BULLETIN OF PROSTHETICS RESEARCH. SPRING 1979.(U)
1979 E F MURPHY
UNCLASSIFIED BPR-10-31 NL

1 OF 6
AD A070587



BPR 10-31 SPRING 1979

AD A070587

Bulletin of Prosthetics Research

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DDC
RECEIVED
JUN 29 1979
A

REHABILITATIVE ENGINEERING RESEARCH AND DEVELOPMENT

06 18 082

DDC FILE COPY

DEPARTMENT OF MEDICINE AND SURGERY
VETERANS ADMINISTRATION . WASHINGTON, D. C.

LEVEL II 14

BPR-10-31 SPRING 1979

(10) Eugene F. Murphy (1)

Bulletin of Prosthetics Research

(6) Spring 1979

(12) 494 p.

DDC
RECEIVED
JUN 29 1979
A

REHABILITATIVE ENGINEERING RESEARCH AND DEVELOPMENT

(11) 1979

DEPARTMENT OF MEDICINE AND SURGERY
VETERANS ADMINISTRATION . WASHINGTON, D. C.

411 253

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

EDITORIAL BOARD

VERNON L. NICKEL, M.D., *Chairman*

EUGENE F. MURPHY, Ph.D., *Editor*

William M. Bernstock
Bruce B. Blasch, Ph.D.
Paul W. Brand, F.R.C.S.
Ernest M. Burgess, M.D.
Dudley Childress, Ph.D.
Franklyn K. Coombs
Carlo J. DeLuca, Ph.D.
Lois Elliott, Ph.D.
Howard Freiberger
Richard Leclair
H. Richard Lehneis, Ph.D., C.P.O.
Harry Levitt, Ph.D.
John Lyman, Ph.D.
Make McDermott, Ph.D.
Paul R. Meyer, M.D.
Wesley Moore, M.D.
M. Patricia Murray, Ph.D., R.P.T.
Patrick W. Nye, Ph.D.
Edward Peizer, Ph.D.
James B. Reswick, Sc.D.
G. Heiner Sell, M.D.
F. Thomas Shipp, Ph.D.
Anthony Staros
Robert E. Stewart, D.D.S.

EDITORIAL STAFF

TAMARA T. SOWELL, B.S., R.P.T., *Associate Editor*
STANLEY DALY, JR., *Managing Editor*

Medical Consultant: Gustav Rubin, M.D.
Technical Consultant: Leon Bennett, M.A.E.
Editorial Consultant: Wilfred G. Holsberg
Circulation Manager: Selma Denkenson
Technical Information Specialists: Lily W. Hom; Thomas R. Langan
Photographer: Berdsell Franklin

The *Bulletin of Prosthetics Research* is a publication of the Rehabilitative Engineering Research and Development Service, Department of Medicine and Surgery, Veterans Administration. The opinions expressed by contributors are their own and are not necessarily those of the Veterans Administration. Address correspondence to Editor, *Bulletin of Prosthetics Research,* Office of Technology Transfer, Veterans Administration, 252 Seventh Avenue, New York, New York 10001.

Contents of this Bulletin are within the public domain and not under copyright except as noted here. No works subject to copyright protection appear in this issue. All material in this issue may be reproduced without permission.

Library of Congress Catalog Card No. 6—60273.

Distribution CO:		(00) (001) (10) (10a) DFO (11) (111) (111B)
SS (153)		(111D) (112) (121) (112G) (112J) (113) (141)
SSD		(142D1) (15) (151) (152) (153)—1 ea.
	FLD	HA, DO, OC, OCRO—in varying quantities
	EX	P DI

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402
Stock Number 051-000-00130-3

Accession For
NTIS GRA&I
DDC TAB
Unannounced
Justification
By
Distribution/
Availability Codes
Dist. Avail and/or special
A 24

CONTENTS

Articles *Page*

Editorial—Amputation as Cause of Cardiovascular Disorders —*L. B. Hobson* 1

Congress Emphasizes Rehabilitation Research —*S. E. Roodzant and J. G. Clements* 3

Muscle Alone is Not Enough—an Essay—*J. Lyman* 11

Transferring Load to Flesh: Part IX Cushion Stiffness Effects —*L. Bennett and H. Patel* 14

Locomotion Assistance Through Cane Impulse—*L. Bennett, M. P. Murray, E. F. Murphy, and T. T. Sowell* 38

VA Rehabilitative Engineering Research and Development Service Programs

Prosthetics—Edited by *E. F. Murphy* 48
Sensory Aids—Edited by *H. Freiberger* 146

VA Prosthetics Center
Report—*A. Staros and E. Peizer* 164

Departments

Notes and News 208
Recent Patents 217
Publications of Interest 219
Calendar of Events 227

Index to the Bulletin of Prosthetics Research from BPR 10-21 Spring 1974 through BPR 10-30 Fall 1978 — A Five Year — Ten Issue — Cumulative Index 231

Bull. Prosth. Res., BPR 10-31, Spring 1979.

AMPUTATION AS CAUSE OF CARDIOVASCULAR DISORDERS

Lawrence B. Hobson, M.D., Ph. D.

Deputy Assistant Chief Medical Director for Research and Development
Department of Medicine and Surgery
Veterans Administration
Washington, D.C. 20420

. . . an editorial

When the Veterans Administration was charged with determining whether amputation was a causal factor in cardiovascular diseases, there was general skepticism that such a relation existed. Indeed, a review of the scientific literature increased the doubts. It now seems that we were wrong and some interesting new research prospects have appeared.

The story begins when Congress, stimulated by a veterans organization, passed the Veterans Disability, Compensation, and Survivor Benefits Act of 1976 (Public Law 94-433). The Act mandated two studies: critical review of the extant scientific information and an epidemiological study of veterans who had amputations as a result of injuries. Initially the Act allowed only 9 months to complete both assignments. The literature review could be and was finished within this period, but the epidemiological study could not possibly be conducted within so short a time so that its completion and submission were rescheduled for the end of February of this year.

The literature review included seven studies of the late effects of amputation in England, Finland, Germany, and the United States. None of them included comparisons with appropriate controls, and only one supported the appearance of cardiovascular defects or later increased mortality after uncomplicated amputation of the lower limb. The others found no correlation.

The epidemiological study, conducted by the Medical Follow-Up Agency of the National Academy of Sciences — National Research Council, has been sent to Congress. The authors, Zdenek Hrubec and Richard A. Ryder, determined the mortality rates among 12,000 army veterans who were hospitalized for trauma during 1944 and 1945. The men were divided into several groups: amputation at or above

the knee or at or above the elbow ("proximal" amputations), amputation of part of a hand or a foot ("distal" amputation), and disfiguring injury not requiring amputation. The followup period extended from January 1946 to April 1977.

"Proximal" amputation of the lower limb resulted in an overall mortality approximately 1.4 times as great as that among disfigured veterans. Mortality from ischemic heart disease was more than 1.5 times as great and from other cardiovascular diseases was almost 1.7 times as large. Bilateral leg amputation carried an even larger overall risk but "distal" amputees and arm amputees were at no definitely increased risk of dying.

The epidemiological study is by far the best-controlled large study of the impact of amputation on life expectancy. It does not—nor was it designed to—reveal the causal mechanisms of the effects observed. Drs. Hrubec and Ryder offered several suggestions, the most likely of which relate to physical activities of upper-leg amputees. It is not clear, however, whether the increased exertion required for amputees to walk or the decreased exercise due to the handicap is responsible. Both may play a part but further research will be needed to determine why amputation adversely affects the cardiovascular system.

One thing seems likely—there is more reason than ever to amputate at as low a level as possible, even in young people without preexisting cardiovascular diseases. It is even more reasonable to follow the same course when the patient already has an impaired circulatory system, as is usually the case in civilian practice today.

If causal mechanisms can be found, the post-operative management of lower limb amputees could be tailored to reduce the risk of later cardiovascular difficulties. This is an area where collaborative research of cardiologists, orthopedic surgeons, and later of prosthetists, physical therapists, and rehabilitation experts offers opportunities for major contribution to solving the problems of amputees.

Editor's Note—The complete literature survey and the subsequent statistical study have been published as 96th Congress, 1st Session, Senate Committee Print No. 6, Causal Relationship Between Service-Connected Amputation and Subsequent Cardiovascular Disorders, Studies Submitted by the Veterans Administration Pursuant to Section 403, Public Law 94433, to the Committee on Veterans Affairs, U. S. Senate, February 15, 1979, U. S. Government Printing Office.

A scientific paper based on these studies has also been submitted to a professional journal.

Bull. Prosth. Res., BPR 10-31, Spring 1979.

CONGRESS EMPHASIZES REHABILITATION RESEARCH

Sherman E. Roodzant
John G. Clements

Professional Staff Members
Committee on Science and Technology
United States House of Representatives
Washington, D.C. 20515

INTRODUCTION

During the recently concluded 95th Congress, much legislative emphasis was placed by the Congress on research programs to aid the handicapped. The impetus for the emphasis was initiated by the House Committee on Science and Technology, under the leadership of the Committee Chairman Olin E. Teague (D-Tex.), the former Chairman of the House Veterans Affairs Committee. The Committee recognized that much was to be gained by directly applying this nation's vast scientific and technological expertise to the problems caused by disability and several legislative measures were adopted following the studies and recommendations of two consultant advisory Panels on Research Programs to Aid the Handicapped commissioned by the Committee. Both Panels were chaired by William A. Spencer, M.D., Director, Texas Institute for Rehabilitation and Research, Houston, Texas.

These consultant advisory Panels were comprised of clinicians, engineers, consumer organization representatives, and government research executives. Representing the Veterans Administration on the Panels were Wilfred Holsberg, Chief, Prosthetics Field Operations; Thomas F. Newcomb, M.D., then Assistant Chief Medical Director for Research and Development, and Vernon Nickel, M.D., Director, Rehabilitative Engineering Research and Development, each of whom played a key role by contributing expertise and knowledge to the final Panel recommendations.

Over the years many studies and reports indicated a critical deficiency in the completeness and extent, and the lack of overall direction in our nation's research programs to aid disabled persons. Recently, several prominent studies and reports cited the potential for

establishing a national research program, e.g., the National Academy of Sciences' report on "Science and Technology in the Service of the Physically Handicapped" (October 1976), the White House Conference on Handicapped Individuals (May 1977), Committee on Science and Technology "Report of the Panel on Research Programs to Aid the Handicapped" (April 1977 and March 1978), and the National Science Foundation-sponsored Texas Tech Study "Technology Assessment: Human Rehabilitation Techniques" (August 1977). These studies all had a profound impact and formed the basis for several legislative actions during the 95th Congress.

NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) Authoritization Act for Fiscal Year 1979 (P.L. 95-434) authorized $2 million for a handicapped research program in the Applied Sciences Research Applications Directorate of the Foundation. The NSF, throughout a number of its Directorates, is supporting a significant amount of select pioneering research projects (e.g., computerized, automated artificial limbs, electromagnetic stimulation and regeneration of bone, and nerve implant prostheses for nerve regeneration) and is exploring other problems of the disabled which indicate that much progress and great public benefit can be realized through federally-sponsored research projects which address the problems of the disabled.

These types of innovations require a multidisciplinary research approach which includes not only the natural sciences and engineering but the social (legal and economic) and medical sciences. The NSF has this expertise, the capability and the necessary organization in place to carry many of these successful basic projects through the applied research and feasibility phases, ensuring the timely availability of these efforts to the service delivery system and the disabled population.

The Congress is concerned that, too often, successful basic research projects lack the attention and further Federal assistance to carry them through the feasibility and implementation processes. Therefore, the Congress has directed the NSF's Applied Science and Research Applications Directorate to establish a science and technology program focused on the problems of the disabled. The Foundation has the coordinating mechanisms available to establish such a program and is directed to establish the program in a cooperative mode with the other Federal agencies dedicated to serving the disabled.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Following the recommendation of the consultant advisory Panel on

Research Programs to Aid the Handicapped, the Congress increased the responsibility of the National Aeronautics and Space Administration (NASA) by amending the statutory NASA charter to include bioengineering for the handicapped. In P.L. 95-401, Congress declares that the general welfare of the United States requires that the unique competence of NASA in science and engineering systems be directed to assisting in bioengineering research, development, and demonstration programs designed to alleviate and minimize the effects of disability.

Although $4 million was authorized to be appropriated for this activity in the original legislation, the final appropriation action cut deeply into the space program budget, and it is questionable at the time of this writing what bioengineering research NASA will be able to sponsor in Fiscal Year 1979.

NATIONAL INSTITUTE OF HANDICAPPED RESEARCH

Another major action which indicates Congressional interest and emphasis on rehabilitation research was the passage of H.R. 12467 (P.L. 95-602), initially introduced in the House of Representatives by Representative John Brademas (D-Ind.), Chairman of the Subcommittee on Select Education, Committee on Education and Labor and subsequently introduced by Senator Jennings Randolph (D-W.Va.), Chairman of the Subcommittee on the Handicapped, Committee on Human Resources. On November 6, 1978, the President of the United States signed H.R. 12467 into law. Besides the creation of a National Institute of Handicapped Research (NIHR), among other elements Public Law 95-602 also contains provisions for an Interagency Committee on Handicapped Research (ICHR) and a National Council on the Handicapped (NCH), major recommendations of the House Science Committee's Panel on Research Programs to Aid the Handicapped. These three elements are paramount for coordination and cooperation among the various Federal agencies involved with handicapped individuals and will maximize the utilization of our nation's vast scientific and technological resources in addressing the problems caused by disability.

The House Committee on Education and Labor committee report on this legislation explained that "research regarding the needs of handicapped people for greater independence demands the same quality of leadership and institutional visibility as research regarding disease prevention such as sponsored by NIH". Senator Randolph quite vividly explained that the "rehabilitation research program has long been recognized as the life's blood of new ideas for improving services to the disabled". In the Congressional debate that led to establishing the NIHR, it was noted that the HEW rehabilitation research

budget for Fiscal Year 1978 was actually less than the budget for Fiscal Year 1967; in 10 years this budget dropped from $32 million to $31.5 million. This did not represent frugality on the part of Congress but a lack of leadership and commitment on the part of the previous administration. Senator Randolph went on to say that the NIHR may be the brightest star in the future of rehabilitation services.

This NIHR, headed by a Director appointed by the President (Executive Level V), will both finance and coordinate Federal research activities affecting the lives of handicapped people. Specifically, it is envisioned as a focal point to expand the scientific base of rehabilitation, improve the skills and knowledge of rehabilitation professionals in the most modern technology available, contribute to better analysis and planning in the rehabilitation field, and place research and development in the field of the handicapped on a more equitable standing with the best of research and development in the fields of medicine and education. The purposes of the NIHR are—

1. To provide for a comprehensive and coordinated approach to the administration and conduct of research, demonstration projects, and related activities for the rehabilitation of handicapped individuals, including programs designed to train persons who provide rehabilitation services and persons who conduct research;

2. To facilitate the distribution of information concerning developments in rehabilitation procedures, methods, and devices to rehabilitation professionals and to handicapped individuals to assist such individuals to live more independently;

3. To improve the distribution of technological devices and equipment; and

4. To increase the scientific and technological information presently available in the field of rehabilitation.

With these purposes in mind, the NIHR may very well extend to all disabled persons, through an expanded commitment and utilization of the latest research in freeing handicapped individuals from dependent, life-threatening, and life-shortening conditions. To promote this goal the Institute will be responsible for:

1. Conducting research with public and private organizations, and administering the research and training center program—

a. research with private as well as public organizations;

b. research in other rehabilitation services as well as vocational;

c. research, including basic research when related to rehabilitation techniques and service;

d. establish and support rehabilitation research and training centers;

e. conduct research in the area of telecommunications systems;

f. conduct a program of joint projects with the National Insti-

tutes of Health, Health Services Administration, Administration on Aging, National Science Foundation, Veterans Administration, Office of Education, National Aeronautics and Space Administration, other Federal agencies, and private industry in areas of joint interest involving rehabilitation; and

g. conduct a program of research related to handicapped children and individuals who are aged 60 and over.

2. Disseminating information acquired through research funded by the NIHR to other Federal, State, and local public agencies and to private organizations engaged in research relating to rehabilitation or providing rehabilitation services;

3. Coordinating, through the Interagency Committee established by Section 203 of this Act, all Federal programs and policies relating to research in rehabilitation;

4. Disseminating educational materials to primary and secondary schools, institutions of higher education, and to public and private entities concerning how the quality of life of handicapped individuals may be improved.

5. Conducting an education program to inform the public about ways of providing for the rehabilitation of handicapped individuals, including information relating to family care and self care;

6. Conducting conferences, seminars, and workshops (including in-service training programs) concerning research and engineering advances in rehabilitation pertinent to the problems of handicapped individuals;

7. Taking whatever action is necessary to keep the Congress fully and currently informed with respect to the implementation and conduct of programs and activities carried out under this legislation;

8. Producing, in conjunction with the Department of Labor, the National Center for Health Statistics, the Bureau of the Census, the Social Security Administration, and other Federal departments and agencies, as may be appropriate, statistical reports and studies on the employment, health, income, and other demographic characteristics of handicapped individuals and disseminating such reports and studies to rehabilitation professionals and others to assist in the planning and evaluation of vocational and other rehabilitation services for the handicapped;

9. Scientific review through the Director of all research grants and programs over which he has authority by utilizing, to the maximum extent possible, appropriate peer review groups established within the NIHR and composed of non-Federal scientists and other experts in the rehabilitation field;

10. Development of a long-range plan for rehabilitation research which shall—

a. identify any research which should be conducted respecting

the problems encountered by handicapped individuals in their daily activities, especially problems related to employment;

b. determine the funding priorities for research activities under this program and explain the basis for such priorities, including a detailed description of any new types of research recommended for funding; and

c. specify appropriate goals and timetables for activities to be conducted under this program.

11. Promote, through the Director, cooperation among Federal departments through the Interagency Committee on Handicapped Research and consultation with Administrators of research programs with regard to design of research projects, results and applications; and

12. Take whatever actions appropriate to provide for a comprehensive and coordinated research program under this law; and that any person responsible for administering any such program shall, through the Interagency Committee, consult and cooperate with the Director in carrying out this program.

Through these program objectives the Institute will ensure that the practical products of basic research will ultimately be transferred and disseminated to the disabled themselves, thus providing great potential for improving their lives.

INTERAGENCY COMMITTEE ON HANDICAPPED RESEARCH

Another key element to this program is an Interagency Committee on Handicapped Research (ICHR). The ICHR must become an effective integrating agent to promote interagency cooperation, joint-funding and information dissemination of the latest in scientific and technological endeavors. In addition to the previously mentioned cooperative linkage with the NIHR, it will:

1. Promote coordination and cooperation among Federal departments and agencies conducting rehabilitation research programs by its interagency structure composed of the National Institute of Handicapped Research; Rehabilitation Services Administration; Office of Education; National Institutes of Health; Veterans Administration; National Aeronautics and Space Administration; Department of Transportation; National Science Foundation and such other members as the President may designate;

2. Identify, assess, and seek to coordinate all Federal programs, activities, and projects, and plans for such programs, activities, and projects with respect to the conduct of research related to rehabilitation of handicapped individuals; and

3. Submit a report to the President and to the appropriate committees of the Congress making recommendations as the Committee

deems appropriate with respect to coordination of policy and development of objectives and priorities for all Federal programs relating to the conduct of research related to rehabilitation of handicapped individuals. In order to establish a close liaison and continuity of effort both Houses agreed that the Director of the NIHR would be the Chairman of the Interagency Committee, thus, emphasizing the Congressional intent of promoting cooperation among research entities.

NATIONAL COUNCIL ON THE HANDICAPPED

The final element, which will emphasize the importance of the research activities within the rehabilitation field with regard to disabled persons, is the National Council on Handicapped (NCH). With programs affecting disabled persons fragmented across many Federal departments and agencies, a balanced, comprehensive, cohesive program can be achieved only if governmental and private representatives work together on planning, directing, and coordinating the total national effort. To that end, it is imperative that handicapped individuals participate significantly in the program, both as working members of the organization and as members of the NCH. This government-consumer-professional-industry partnership will be embodied in the NCH with representatives of handicapped individuals, national organizations concerned with the disabled, providers and administrators of services to the disabled, individuals engaged in conducting medical or scientific research relating to the disabled, business concerns and labor organizations. The NCH will link the NIHR and other Federal agency programs and will be the primary vehicle for adequately communicating the needs of disabled persons at the highest levels of government.

The duties of the NCH shall be:

1. To establish general policies for, and review the operation of the NIHR;
2. To provide advice to the Commissioner of the Rehabilitation Services Administration (RSA) with respect to the policies of and conduct of RSA;
3. To advise the Commissioner of RSA, the appropriate Assistant Secretary of the Department of Health, Education, and Welfare (HEW) and the Director of the NIHR on the development of the programs to be carried out under P.L. 95-602;
4. To review and evaluate on a continuing basis all policies, programs, and activities concerning handicapped individuals and persons with developmental disabilities conducted or assisted by Federal departments and agencies including programs established or assisted under this Act or under the Developmental Disabilities Assistance and

Bill of Rights Acts, in order to assess the effectiveness of such policies, programs, and activities in meeting the needs of handicapped individuals;

5. To make recommendations to the Secretary of HEW, the RSA Commissioner, and the Director of the NIHR regarding ways to improve research concerning handicapped individuals, and the methods of collecting and disseminating the findings of such research, and make recommendations to facilitate the implementation of programs based upon such findings; and

6. To submit, beginning in 1980, an annual report to the Secretary of HEW, the Congress and the President to include (a) a statement of the current status of research concerning the handicapped in the U.S., (b) review of activities of RSA and NIHR, and (c) such recommendations respecting the items described in clauses (a) and (b) as the NCH considers appropriate.

Emphasis on rehabilitation research affirms the congressional intent to bring technological developments and their application to rehabilitation problems. Improving the management of research, technology development and applied engineering for the disabled, and developing a more comprehensive research program between Federal agencies interested in research for the disabled, will be priority missions under P.L. 95-602.

The National Institute of Handicapped Research will be charged with the delicate task of planning and implementing research and development strategies critical to the problems relating to disability and enlisting professionals with expertise which can be brought to bear in new ways on these problems. The NIHR is to develop, conduct, and coordinate an innovative research program which actively seeks solutions to the many and varied problems experienced by disabled persons. It has a broad mandate to coordinate Federal rehabilitation research programs and policies, conduct special studies, disseminate research findings, and inform the community—both professional and consumer—with regard to the latest developments in rehabilitation research and engineering.

From these several Acts of Congress, it is clearly seen that there is tremendous support and interest in the Congress for rehabilitation research. It is up to each one of us now to use these funding resources to exploit the latest scientific and technological advances in overcoming or alleviating the problems caused by disability.

Bull. Prosth. Res., BPR 10-31, Spring 1979.

MUSCLE ALONE IS NOT ENOUGH

John Lyman, Ph. D.[a]

Professor of Engineering and Psychology
Biotechnology Laboratory
Engineering Systems Department
School of Engineering and Applied Science
University of California
Los Angeles, California 90024

. . . an Essay

Irritability, the property of response to the forces in the environment, is present in even the more primitive living cells. If a weak electric shock or touch is applied to an amoeba, it will immediately respond with a movement exemplified by a flow of its protoplasm. It will also respond to temperature, oxygen, pH, and various other environmental stimuli. Yet this primitive single-cell organism has no observable specialized "sensory" system. It is "all sensor".

This state of affairs has become incredibly refined as we move up in the evolutionary scale. Nevertheless a fundamental principle has remained the same: there is an enormous ratio of sensory input capability relative to motor output capability. For humans, it probably is not feasible to estimate with any precision, but it is compellingly evident that the sensory side is many-fold greater than the motor side, perhaps even in ratios of billions or trillions to one.

The philosophical question is: what is the function that nature has achieved by providing such a rich sensory capability, and what is its role in relation to patterns of behavior? I would like to speculate a bit on this matter, particularly on how sensory feedback relates to rehabilitative engineering.

Experimentally, it has been demonstrated many times that various sensory responses are coordinated into a whole that provides a multidimensional "solid" image of the environment. This image permits all the processes of survival to take place by focusing needs and coordinating them with environmental resources, the global expectation being optimal fulfillment for the living system.

Loss of one sense, or even of more than one sense, in higher living forms does not necessarily destroy this environmental image, though

[a]Dr. Lyman is a member of the Editorial Board of the BPR.

the total amount of inflowing information may be enormously reduced. For example, some well-trained congenitally blind and even deaf-blind persons have developed a great enough idea of their spatial involvement using touch, kinesthesia, and their other remaining senses to be able to draw representations of objects without visual feedback. A fairly accurate concept of dimensionality has been developed. Yet we do not expect people with such handicaps to perform appropriately in dimensions for which their lost senses are primary; for example, color. Clinically, we are helpless in such circumstances. We cannot give back what genetic circumstances have taken away at a primary level. But we can give back degrees of functions in proportion to that level of technology which we have achieved and, through use, have satisfactorily evaluated. Rehabilitation requires ingenuity in adapting available technology to bypass the missing sense.

Each time a new event of fundamental importance takes place in technology, there seems to be a mad rush to see how it can be applied to the problems of humankind. Both government and industry support such efforts, often with the help of dedicated and ingenious individuals. Such is the case with current development in the area of manmade sensors. On a more and more microscopic level, it is becoming possible to sense virtually all the energies of interest to survival in biological systems. Light and sound are only the beginning! Specialized differentiation of various chemical and thermal components at a micro level is becoming more feasible each day. Of course, display of such information in real time, in a way requiring minimal conscious attention for interpretation, and with low-cost, low-power, compact, portable equipment — is largely unsolved today.

However, the implication for humans is that detailed recognition of environmental factors influencing decisions regarding immediate behavior, with refined display systems, is a reasonable technological expectation. In the broadest terms, the whole behavior of a living organism becomes a matter of its own parts being continuously influenced by each minute change in the local environment to supply a mass of information which is processed in a secondary order of neural synapses. Decisions are reached that, in turn, are transmitted to a primary order of processors which control coordinated changes in the ultimate effector (muscle) forces, and thus cause an appropriate movement. In contrast, even though microprocessor technology is rapidly developing, present devices are far below the level of sophistication of the nervous system.

The hierarchical nature of natural sensory input, from the micro-identification of events in the environment to the refinement of data into macrocommunication and control events, is evidently why sensory systems exist. With multimodal senses more information is obtained, hence complex relations within the environment can be developed. A

simple reach and grasp can be converted into a refined movement representing the skill of a musician, artist, or master craftsman.

In the world of prosthetics, direct attention to sensory feedback has been minor compared with attention to motor activity. Sensory feedback systems possess great potential for definition and for refinement of the information flow for "fine tuning" at the micro level, which, in turn, makes possible the seemingly smooth transition to macro movements. Traditionally, utilization of this potential has been an area of little clinical concern, and "successful" rehabilitation has generally accepted standards that are far removed from fully normal performance. This tolerance is quite understandable. Some regain for improvement in function is better than none at all. It is simply not practical to wait for "perfect" technology.

Nonetheless, while we struggle to obtain deeper understanding of the mechanism of the structural functional relationship so exquisitely designed in natural products, each small step, whether in concept or in practice, becomes an increment, a building block, whose values goes beyond cost/effectiveness and the urgency of immediate general application. Though even modest improvement in artificial sensory feedback can be helpful, understanding in detail how to use it in the most general and efficacious manner must necessarily remain an area for advanced research and development, with low expectation for a prompt breakthrough revolutionizing day-to-day use.

Basic science in the area of sensory feedback moves ahead at a rate commensurate with the quality of talent as well as the resources applied toward it. Substantial progress then depends on dedication and persistence. Living creatures had to get beyond the amoeba's protoplasm flow before muscle could evolve.

In my view, the promise is great but cannot be taken for granted.

Bull. Prosth. Res., BPR 10-31, Spring 1979.

TRANSFERRING LOAD TO FLESH: PART IX CUSHION STIFFNESS EFFECTS[a]

Leon Bennett M.A.E.
Chief, Mobility Engineering Laboratory
VA Prosthetics Center
252 Seventh Avenue
New York, New York 10001

Himanshu Patel M.S.[b]
Research Assistant
Department of Mechanical Engineering
Columbia University
New York, New York 10027

ABSTRACT

Stresses developed within flesh in contact with a cushion are examined analytically. Compressive, tensile, and shear stresses within flesh in proximity to a bone are given as a function of cushion stiffness (major parameter) and the overall Poisson's ratio of flesh (minor parameter).

It is shown that an individual already sitting on a soft cushion recieves relatively minor benefit when a still softer cushion is substituted. This result follows from the fairly flat (saturated) trend of both shear and tensile stress with respect to cushion stiffness, once the soft cushion domain (less than 10 PSI) is entered. Only flesh normal stress (compression) responds significantly to incremental changes of stiffness within the soft cushion range; reducing the cushion stiffness 50 percent will typically reduce local compressive stress by roughly 20 percent. While such a gain is real, it is also modest.

INTRODUCTION

Our concern is with soft-tissue trauma developed by the handicapped. In particular, pressure sores resulting from prolonged contact

[a]This work is based on work performed under sponsorship of the Veterans Administration in cooperation with the HEW-RSA, program 13.627.
[b]Mr. Patel was supported in part under HEW-RSA grant 23-P-59173/2-02.

with a loading member (orthosis, cushion, bed, prosthesis, etc.) are the subject of this series of articles. At issue is the practical problem of how trauma can be prevented.

While we do not fully understand the etiology of decubiti, it is clear that the intensity of stress within soft tissue is related to trauma, albeit in a complex fashion (1). To advance in this area, it would be useful to understand the manner in which stress within flesh is distributed as a function of anatomy, cushioning, and load.

In this particular work we address the following question: What is the effect of cushion stiffness on those flesh stresses experienced in proximity to the cushion? For example, are soft cushions more effective than hard cushions in reducing the stress within flesh?

To solve this question we shall employ an analytical procedure of severely limited power. Unfortunately, the complexities of flesh as a material are so great as to force the employment of a number of simplifying assumptions in order to achieve a practical solution. For example, it is well known that soft tissue is viscoelastic, discontinuous, non-linear, anisotropic and history-dependent. To treat with the full complexities of such a material is well beyond the current state of stress analysis. In the particular analysis pursued here, we shall take soft tissue to be "well behaved" and linear. In other words we are ignoring the viscoelastic, discontinuous, non-linear, anisotropic, and history-dependent reality in favor of a far simpler, "ideal" material. Such a course is not without danger and the reader may well inquire concerning the realism of results generated in such a fashion.

Lacking experimental results in the form of actual stress measurements in flesh, we are unable at the present time to attest to the accuracy of our procedures. We can say that experimental tests conducted upon gels reputed to be fleshlike in their characteristics have confirmed the existence of every major stress trend revealed by the type of analysis given below (2). While not satisfactory as proof of modelling veracity, the essential agreement between mathematical and gel physical models does offer hope of ultimate modelling confirmation through animal tests.

Noting these uncertainties, how is the material best used? We believe the results fall somewhere between the qualitative and the quantitative in their predictive power. Prudent usage suggests that powerful trends be viewed seriously; however, in all likelihood, minor quantitative differences are not significant.

METHOD OF PROCEDURE

The basic approach follows that given by Vlasov and Leontev (3), in which elasticity theory, employing the method of displacements, is combined with certain variational techniques to produce a practical

solution to the stress state within a soft medium under load. Classical elasticity theory alone is incapable of generating realistic answers; any attempt to force the employment of elasticity theory produces numerous singularities. Introducing variational concepts permits a more realistic distribution of stress in the neighborhood of physical discontinuities.

The procedure is two-dimensional; i.e., we are considering a slice of cushion, flesh and bone that extends without limit in the z direction, although practical dimensions do exist in the x and y directions. Both the flesh and the cushion are taken to be "well-behaved;" i.e., each possessing a clearly defined modulus of elasticity and Poisson's ratio and experiencing deflection as a linear reaction to stress.

The solution employs the separation of variables method to delineate x and y displacements. The x dependent functions are determined by strain energy techniques. The y dependent functions are approximated by an assumed relationship.

The actual solution to a two-layered model, given as an Appendix to this article, is believed original. However, all of the preliminaries are taken whole from Vlasov and Leontev. Where essential, these preliminaries are repeated in the Appendix. However, for a fuller understanding of the entire process the reader is referred to Vlasov and Leontev.

A full listing of nomenclature is given in the Appendix. While units are optional so long as they are coherent, the actual units employed in our calculations were British Imperial units, such as inches and pounds.

RESULTS

The particular case examined is one where a long bone ($L=5$) presses heavily ($Po=20$) upon flesh possessing a fixed stiffness ($E_{1S}=6.6$) and either of two Poisson's ratios (0.36 or 0.45). The flesh is supported by a cushion of fixed thickness ($h_2=1\frac{1}{2}$) and Poisson's ratio ($\gamma_{2S}=0.15$) (Fig. 1). Cushion stiffness is a major parameter and variations in the range 3.3 to 500 PSI are considered. At issue is the stress level within the flesh as the cushion stiffness is changed.

The form of solution is insensitive to flesh thickness (h_1). Attempts to introduce flesh thickness as a working parameter were defeated by this very lack of sensitivity. Consequently, the actual flesh thickness chosen for calculational purposes ($h_1=1\frac{1}{2}$) was based on considerations of convenience; this value is properly taken as one representing any arbitrary thickness rather than a specific value. Computational results are given in Figures 2–4.

Shear stress maximum values (Fig. 2) depict a basic trend of continuous reduction with increasing cushion stiffness. In other words,

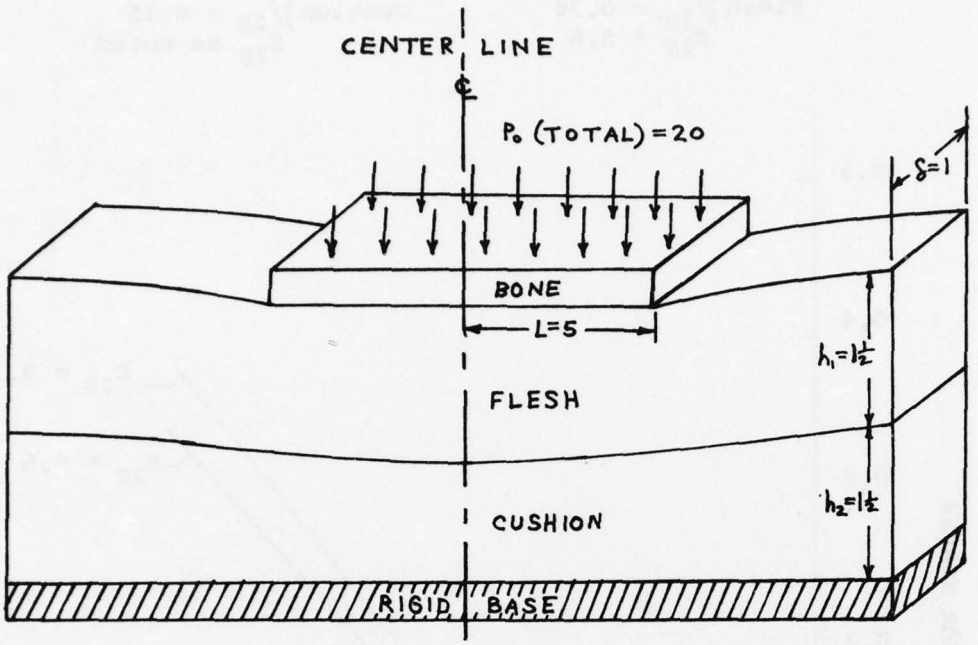


FIGURE 1.—Schematic of flesh loading condition examined in this work. The main parameter is cushion stiffness. Flesh Poisson's ratio is a minor parameter. The output consists of stress within the flesh as a function of major and minor parameters.

the stiffer the cushion, the lower the shear stress. Note further that as the flesh is taken to possess a higher Poisson's ratio, the corresponding shear stresses are somewhat lower.

A typical distribution of shear stress with respect to flesh depth is given in Figure 3. The particular flesh Poisson's ratio represented by the plot is 0.36 and the Young's modulus 6.6. The cushion Poisson's ratio is 0.15 and the cushion Young's modulus is treated as a parameter. Note that flesh shear stress increases continuously as one moves from the bone towards the skin. Thus maximum flesh shear stress values exist at the cushion interface. These maximum values are always located in the vicinity of the bone end.

Normal stresses are given in Figure 4. An upper set of four curves depicts the compressive stresses on the center line and at the bone edge for two different flesh Poisson's ratios. The peak normal stress values shown in Figure 4 can not be associated with any particular flesh depth (as given in the case of shear, immediately above) owing to the use of assumption 5 (see Appendix). Note that in all cases the compressive stress increases in an asymptotic fashion as the cushion stiffness is made larger. At some value of cushion stiffness in the neighborhood of 100 PSI, the compressive stress "saturates"; further increases in cushion stiffness produce a negligible effect on compressive stress. At the other end of the cushion stiffness range (very soft),

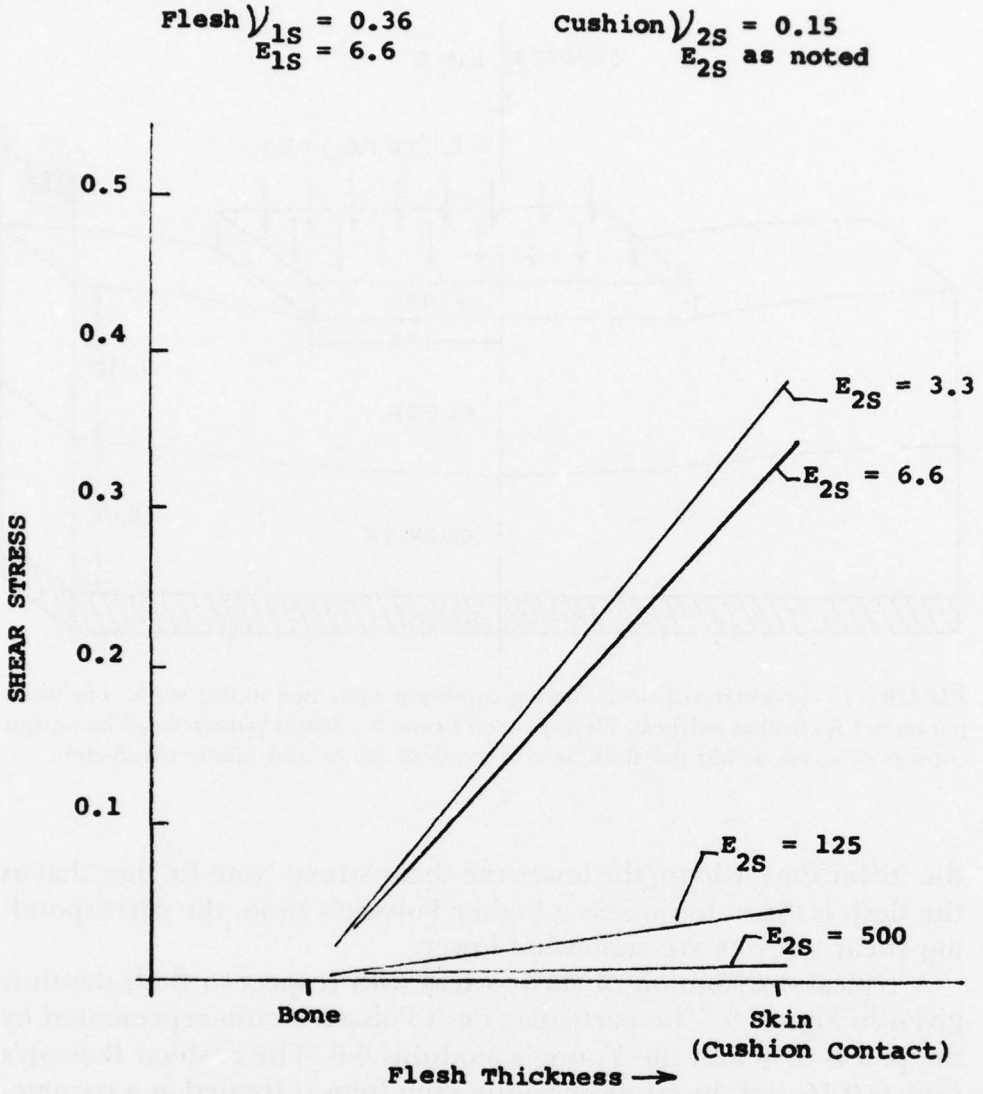


FIGURE 2.—Shear stress. Plotted values are the maximum encountered within the flesh domain of Fig. 1, for Po=20 or an average unit pressure at the bone of 2 PSI.

compressive stress is sensitive to stiffness; a doubling of stiffness produces a significant increase in the compressive stress.

Compressive stress is higher at the bone edge than on the center line and higher in the case of smaller Poisson's ratios as compared to large.

Tension exists immediately beyond the bone edge. The two lower curves (Fig. 4) depict the maximum tension encountered as a function of cushion stiffness. For low values of stiffness, the tensile stress is relatively insensitive to cushion stiffness. As stiffness increases the tension slowly decays, finally becoming negligible when extremely

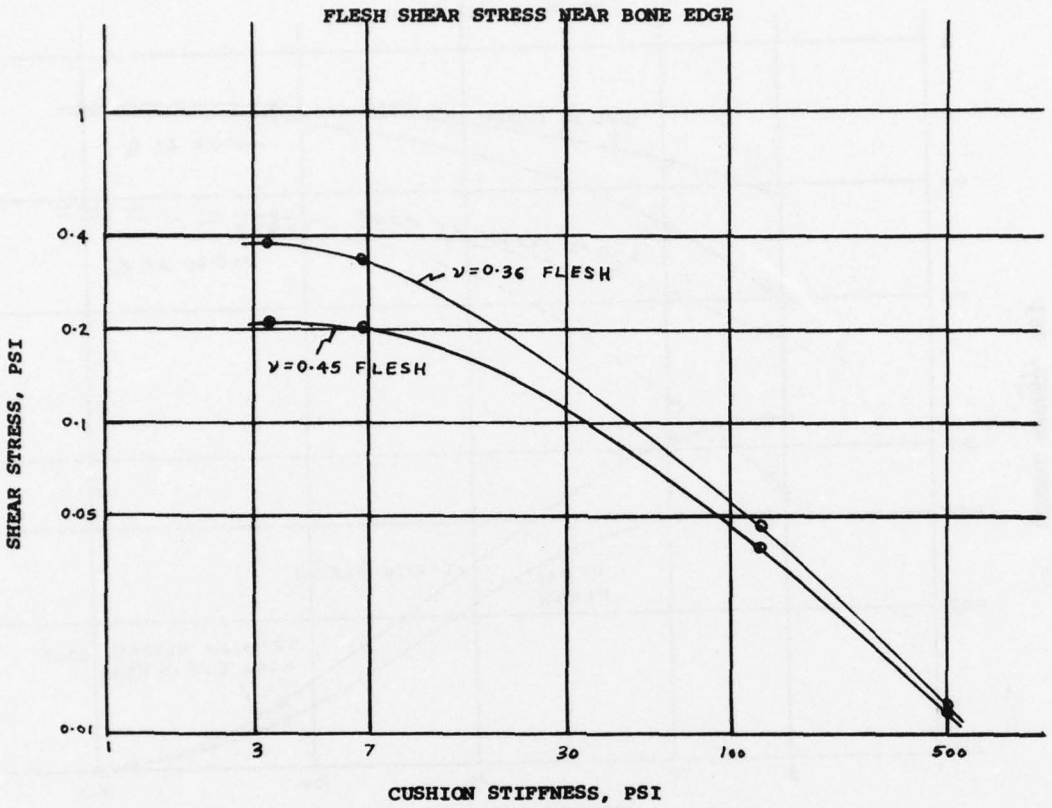


FIGURE 3.—Distribution of flesh shear stress with flesh thickness.

stiff cushions are employed. Tensile stresses are larger in the case of a lower Poisson's ratio.

DISCUSSION

Most practical cushions are quite soft; usually considerably softer than flesh. Given such a soft cushion, of less than 10 PSI stiffness, three forms of flesh stress arise that have significant effects: shear stress near bone edges, tension effects near bone edges, and overall compressive stresses that tend to peak near bone edges. Let us imagine that we are currently employing a soft cushion and wish to reduce the stresses encountered within that flesh contacting the cushion. Is there some benefit to be gained by employing a still softer cushion? Is there any advantage in switching to a stiffer cushion?

From the standpoint of shear stress, there is nothing to be gained in switching to a still softer cushion, if one starts with a soft cushion. (See Figure 2 for stiffness values of less than 10 PSI.) This is also true with respect to tensile stress. (See Figure 4 for stiffness values of less than 10 PSI; lower set of curves.) Where compressive stress values are

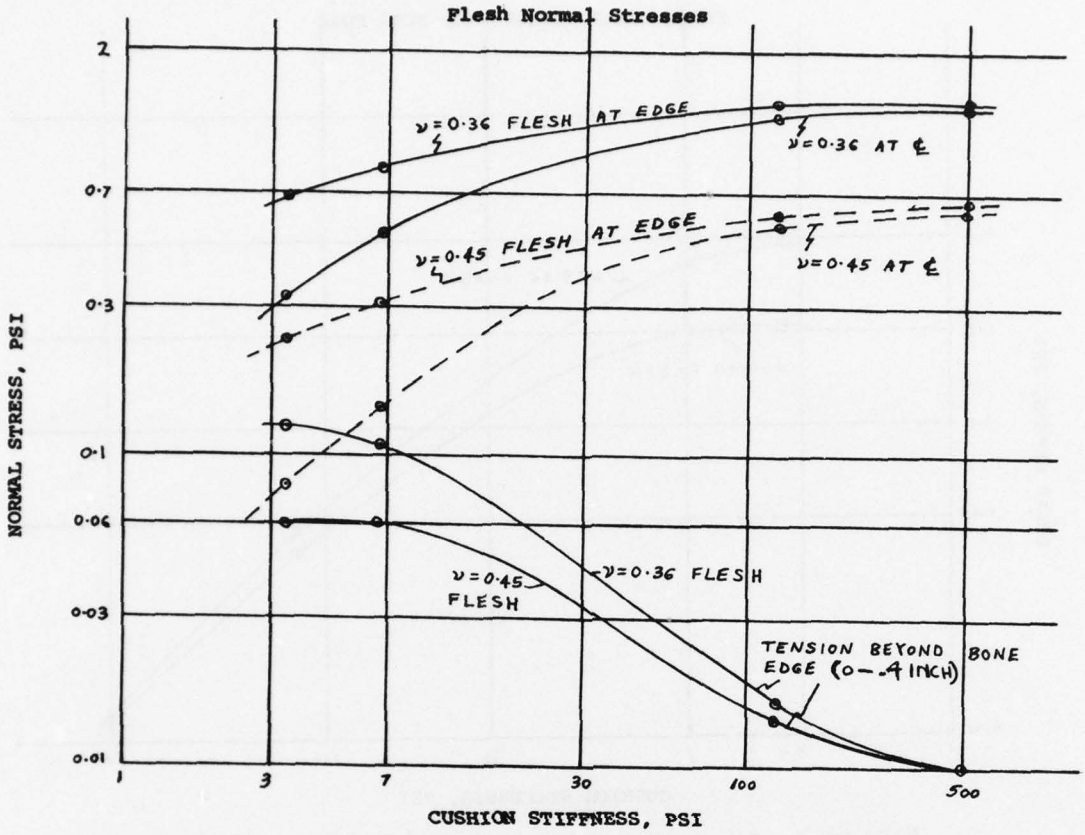


FIGURE 4.—Normal stress. Plotted values are peak values encountered either on the center line (Fig. 1) or in the vicinity of the bone edge, as noted.

concerned there is a gain apparent in the use of a very soft cushion. However, if we utilize the edge stress curve at a Poisson's ratio of 0.45 as being the most realistic and severe of the curve set, it is seen that halving the cushion stiffness will reduce the local compressive stress only 20 percent. While such a gain is real, it is also modest.

One concludes that switching to a still softer cushion from an initial soft cushion can produce only modest gains in one type of stress, local compressive stress. Other active stresses, shear and tension, are either unaffected or actually slightly increased by such a switch. Lacking knowledge of the precise biological effects of each type of stress, we might as a first approximation assume equivalent effects. Then it would appear that the net change in switching from a soft cushion to one still softer is to reduce tissue stress modestly.

As concerns the reverse tendency—switching to a stiffer cushion—the effect is again modest. Shear and tensile values would remain unaffected or decrease slightly, compressive stress values would increase somewhat.

In general, one concludes that variations in cushion stiffness involv-

ing incremental changes of, say, two or three fold in either direction about some soft norm, will produce only modest changes in the stress experienced in the contacting flesh. Mere changes in cushion stiffness do not appear a promising avenue for major reductions in flesh stress.

The distribution of flesh shear stress (Fig. 3) in which maximum values arise near the cushion is intuitively surprising. One anticipates large stress values in proximity to the loading member (bone); the development of large stresses remote from the loading member deserves comment.

Shear stress arises from gradient of compressive deflection. In other words, shear stress reflects the lack of uniformity of the "give" under compressive load. If the compressive deflection were identical everywhere, there would be no shear stress. Where the compressive deflection changes drastically, shear stress is large.

Immediately under the bone the flesh deflection is uniform and the shear stress negligible. It is at the cushion interface that the flesh compressive deflection is both large and uneven. In particular, that section of flesh beneath the bone edge and at the cushion interface experiences the greatest compressive deflection gradient and hence the greatest shear stress (Fig. 4a, appendix).

Photographs taken of a physical model consisting of a flesh substitute (polyvinyl chloride) loaded between a simulated bone and cushion confirm the existence of large flesh strains at the cushion interface. Indeed, still larger shear stress values exist at only one location, the sharp bone corner.

REFERENCES

1. Brand, P.W.: *In* Bedsore Biomechanics. Kenedi, Cowden and Scales, Eds., University Park Press 1976, 19-23.
2. Bennett, L.: Transferring Load to Flesh—State of Effort. Bull. Prosth. Res. 10-22 Fall 1974, 133-143.
3. Vlasov, V.Z. and N.N. Leontev: Beams, Plates and Shells on Elastic Foundations. Moscow 1960. Translated as NASA TT-F-357. Available clearinghouse for Federal Scientific and Technical Information, Springfield, VA. 22151.

ADDENDUM

Some six reviewers have examined the above material; a number of questions have been raised and comments made. What follows is an attempt to list the various issues and provide suitable replies. Hopefully the reader may find some of his own questions reflected here.

1. *Equilibrium Equations*

The equations are but approximations and therefore do not com-

pletely satisfy the equilibrium equations drawn from the theory of elasticity. This limitation is inherent in the Vlasov and Leontev approach. Of course, the final equations do satisfy those equilibrium equations employed in the Vlasov and Leontev procedure.

2. *Equation 14*

One reviewer noted that equation 14 appears to drop out of the derivation. This is true for the reason that the equation is identically satisfied; every term is zero.

3. *Magnitude of q_2*

By definition of the particular loading condition studied, q_2 is zero. Any loading q_1 is independent from q_2 considerations.

4. *Series Terms*

The displacements are expressed as a finite series of which we consider only the first two terms. A question has been raised concerning the loss of accuracy in considering so few terms. We have not conducted an error analysis of the effects of including various numbers of series terms. Such an analysis seems academic when viewed against the background of the numerous gross assumptions (linearity, etc.) made in constructing our model. As we have noted "the results fall somewhere between the qualitative and the quantitative in their predictive power."

5. *Longitudinal Displacement*

The longitudinal displacement (U) is set identically to zero in reflection of the observation that the cushion deflection parallel to a load is far greater than that perpendicular to the load. Such an assumption is standard procedure within the Vlasov and Leontev concept.

6. *Displacement Distribution Functions*

These are chosen as the simplest, capable of yielding coherent results.

7. *Figures 4A and 5A*

These Figures do not provide a scaled portrayal of the deflection characteristics; rather, they represent considerable license on the part of the draftsman. Do not scale these Figures.

8. *Comparison with the Work of Others*

A number of reviewers have suggested a comparison of our results

with the work of others. Unfortunately we know of no comparable analytical or experimental solutions. We have searched the following sources, only to learn in each case that the problem solved was remote from ours:

1. Burmister, D.M., 1956: Stress and Displacement Characteristics of a Two-layer Rigid Base Soil System: Influence Diagrams and Practical Applications. Proc. Highway Res. Board, 35, 773-814. *In* Elastic Solutions for Soil and Rock Mechanics, H.G. Poulos and E.H. Davis, John Wiley and Sons, Inc., New York 113-115, 1974.

2. Fadum, R.E.: Influence Values for Estimating Stresses in Elastic Foundations, 1948. Proc. 2nd Int. Conf. Soil Mechs. Fndn. Engng.; 3:77-84. *In* Elastic Solutions for Soil and Rock Mechanics, H.G. Poulos and E.H. Davis, John Wiley and Sons, Inc., New York, 192, 1974.

3. Fox L.: Computations of Traffic Stresses in a Simple Road Structure, 1948. Proc. 2nd Int. Conf. Soil Mechs. Engng.; 2, 236-246. *In* Elastic Solutions for Soil and Rock Mechanics, H.G. Poulos and E.H. Davis, John Wiley and Sons, Inc., New York; 138-139, 1974.

4. Harr, M.E.: Foundations of Theoretical Soil Mechanics, 1966. McGraw Hill, New York. *In* Elastic Solutions for Soil and Rock Mechanics, H.G. Poulos and E.H. Davis, John Wiley and Sons, Inc., New York, 192, 1974.

5. Harrison, W.J. and C.M. Gerrard: 1972 Elastic Theory Applied to Reinforced Earth, J. Soil Mechs. Fndns. Div., ASCE, 98:(SM12). *In* Elastic Solutions for Soil and Rock Mechanics, H.G. Poulos and E.H. Davis, John Wiley and Sons, Inc., New York, 192, 1974.

6. Milovic, D.M., G. Touzot, and J.P. Tournier: Stresses and Displacements in an Elastic Layer Due to Inclined and Eccentric Load Over a Rigid Strip. Geotechnique, 1970, 20(3):231-252. *In* Elastic Solutions for Soil and Rock Mechanics, H.G. Poulos and E.H. Davis, John Wiley and Sons, Inc., New York, 172-177, 1974.

7. Terzaghi, Karl: Theoretical Soil Mechanics. Fifth Printing, John Wiley and Sons, Inc., New York, 379-382 and 484-485, June, 1948.

8. Tschebotarioff, Gregory P.: Soil Mechanics, Foundations, and Earth Structures. Eighth Printing, McGraw-Hill Book Co., Inc., New York, 215-219, 1958.

9. *"Bone" Contour*

The "bone" employed in our analysis is granted sharp, square corners, a configuration that does not occur in reality. Hence we are dealing with a "worst case"; a more realistic bone model would likely produce lower stresses.

10. *Finite Element Analysis*

Future analytic efforts may well embrace the finite element approach. Many of the inherent limitations of our model can, in princi-

ple, be overcome with this technique. Stipulations of linearity and-normal stress values independent of vertical location are not required in sophisticated finite element treatments. It is to be hoped that the rough approximations resulting from our work will eventually be replaced with the more nearly exact solutions determined from finite element analysis.

APPENDIX

Analytical Solution

The treatment below gives the full development of those equations employed in this work. Much of this effort follows directly on the prior work of Vlasov and Leontev (3). However, starting with equation (25) the remaining effort is believed original.

SYMBOLS	NOMENCLATURE
x, y, z	Cartesian axes rotation
$\varepsilon_{xx}, \varepsilon_{yy}$	Normal strains in x & y respectively
τ_{xy}, τ_{yx}	Shear stresses
$\varepsilon_{xy}, \varepsilon_{yx}$	Shear strains
σ_x, σ_y	Normal stresses
$p(x,y), q(x,y)$	Horizontal & Vertical load functions respectively
E, E_s	Modulus of Elasticity of foundation
ν, ν_s	Poisson's ratio
h_1, h_2	Thickness of foundation layers
H	Total composite foundation thickness
$V_1(x), V_2(x)$	Deflection functions of first & second foundation layers respectively

SYMBOLS	NOMENCLATURE
$u(x,y)$, $v(x,y)$	Horizontal & Vertical displacement functions respectively
$U_i(x)$, $V_k(x)$	Generalized displacements in the horizontal & vertical directions respectively
$\phi_i(y)$, $\psi_k(y)$	Functions of distribution of the displacements in x & y directions respectively
u_j, v_h	Virtual displacements in the x & y directions respectively for $U_j = 1$, $V_h = 1$
$a_{ij}, b_{ij}, c_{jk}, t_{jk}, r_{hk}, s_{hk}, c_{hi}, t_{hi}$	Integrals of functions of distribution of the displacements in x & y
$F(x)$	Function in x
L	Half length of beam
S_h	Shear force
C_o	Displacement under beam in first layer
$C_1, C_2, C_3, C_4, C_1', C_2'$	Constants
P_o	Concentrated vertical load
k_1, k_2, t_1, t_2	Foundation parameters
Ch	Cosh function
Sh	Sinh function
Q_A, Q_B	Vertical reactions at beam ends
q^*	Uniform reaction beneath beam in first layer of foundation
e	2.7183

The following assumptions are made in the derivation:

(1) The displacements in the cushion and flesh and the corresponding strains are small.

(2) The cushion and flesh materials are linearly elastic and isotropic.

(3) The horizontal displacements are negligible.

(4) The bone is infinitely rigid.

(5) The normal stresses in the cushion layers are assumed to be uniform over the cross section.

(6) The loading is symmetrical.

(7) There is no relative movement of one layer with respect to the other in the horizontal direction.

(8) The uniform reaction beneath the bone is a constant and depends upon the deflection and the modulus of the elastic foundation.

(9) The cushions are non-visco elastic and homogeneous.

(10) Poisson's ratio is a constant for the cushion and for the flesh. (Identical values are not assumed.)

(11) There is no cover on the cushion or skin on the flesh.

We are considering problems of plane stress in two dimensions, x & y, and thus the displacements, strains and stresses are functions of x & y only.

Let the unknown displacements be $u(x,y)$ & $v(x,y)$ which are determined from the conditions of equilibrium of the elastic system.

Let the x direction be called longitudinal and the y direction transverse. Hence the corresponding longitudinal and transverse displacements are $u(x,y)$ & $v(x,y)$ respectively. (Fig 1a)

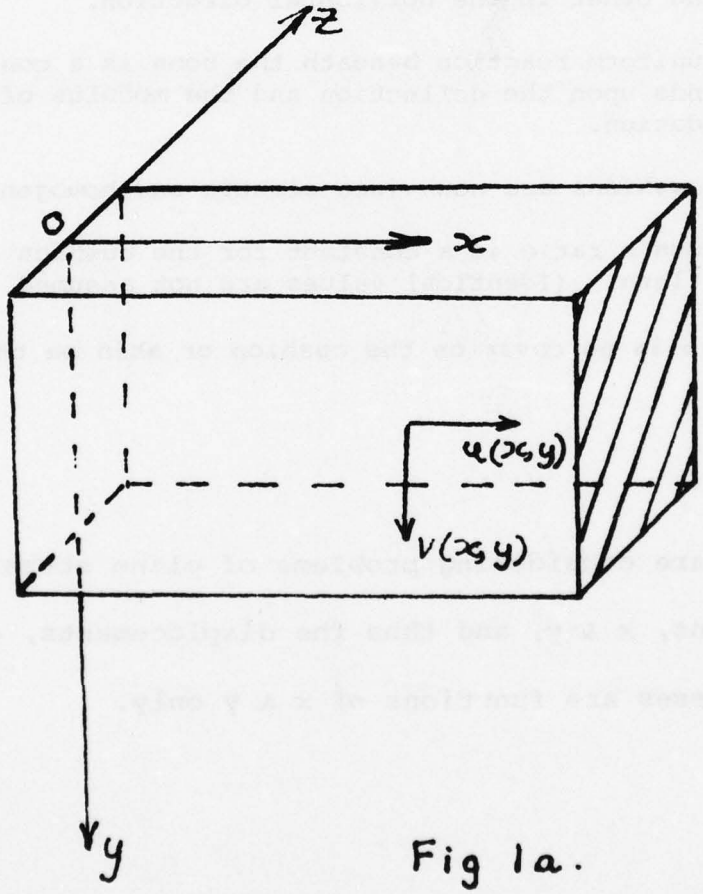


Fig 1a.

The unknown functions $u(x,y)$ & $v(x,y)$ are expanded in a finite series.

Thus, $$u(x,y) = \sum_{i=1}^{m} U_i(x)\, \phi_i(y) \qquad (i = 1, 2, 3, \ldots m) \quad (1)$$

And $$v(x,y) = \sum_{k=1}^{n} V_k(x)\, \psi_k(y) \qquad (k = 1, 2, 3, \ldots n) \quad (2)$$

The functions $\phi_i(y)$ & $\psi_k(y)$ are assumed to be known and the functions $U_i(x)$, $V_k(x)$ to be unknown and having the dimension of length. Here, the functions $\phi_i(y)$ & $\psi_k(y)$ give the distributions of the displacements over the cross section x = const.

The functions $U_i(x)$ & $V_k(x)$ are obtained from equilibrium conditions which are derived by equating to zero the total work of all internal and external forces acting on a strip shown in Fig. 2a over any virtual displacement.

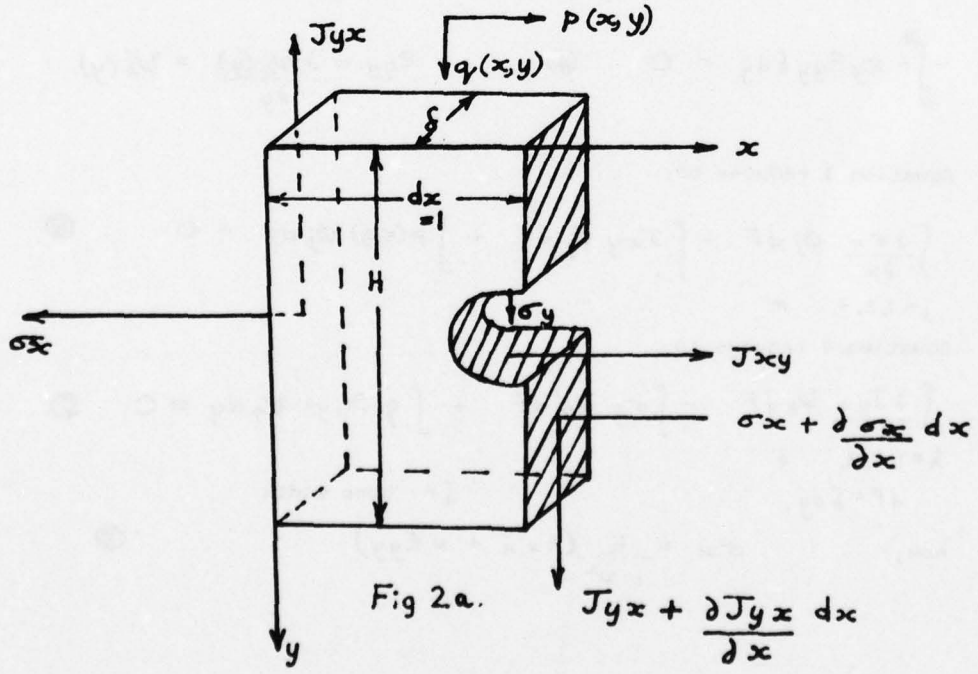


Fig 2a.

$$J_{xy}\frac{\partial \phi_j(y)}{\partial y} = J_{xy}\dot{\varepsilon}_{xy} \qquad \text{as} \qquad \varepsilon_{xy} = \frac{\partial u_j}{\partial y} + \frac{\partial v_h}{\partial x}$$

and $u_j = \phi_j(y)$ for $u_j(x) = 1$, $v_h = \psi_h(y)$ for $v_h(x) = 1$

where

$\phi_j(y)$ = displacement in x direction

$\psi_h(y)$ = displacement in y direction

ε_{xy} = shear strain $= \frac{\partial \phi_j(y)}{\partial y}$, $\varepsilon_{yy} = \frac{\partial v_h}{\partial y} = \psi_h'(y) = \frac{\partial \psi_h(y)}{\partial y}$

ε_{yy} = normal strain

The work done by all the external and internal forces over the strip given a virtual displacement is shown by the following expressions 3 and 4.

$$\int_0^H \sigma_x \phi_j \delta\, dy - \int_0^H -J_{xy}\frac{\partial \phi_j(y)}{\partial y}\delta\, dy - \int_0^H \left(\sigma_x + \frac{\partial \sigma_x}{\partial x}dx\right)\phi_j \delta\, dy$$

$$-\int_0^H p(x,y)\,\phi_j\, dy = 0 \qquad (3)$$

$$\int_0^H J_{yx}\psi_h \delta\, dy - \int_0^H \left(J_{yx} + \frac{\partial J_{yx}}{\partial x}dx\right)\psi_h \delta\, dy + \int_0^H q(x,y)\,\psi_h\, dy$$

$$-\int_0^H -\sigma_y \varepsilon_{yy}\delta\, dy = 0 \qquad (4) \qquad \varepsilon_{yy} = \frac{\partial \psi_h(y)}{\partial y} = \psi_h'(y)$$

Equation 3 reduces to:

$$\int \frac{\partial \sigma_x}{\partial x}\phi_j\, dF - \int J_{xy}\phi_j'\, dF + \int p(x,y)\,\phi_j\, dy = 0 \qquad (5)$$

$j = 1, 2, 3, \ldots m$

Equation 4 reduces to:

$$\int \frac{\partial J_{yx}}{\partial x}\psi_h\, dF - \int \sigma_y \psi_h'\, dF + \int q(x,y)\,\psi_h\, dy = 0 \qquad (6)$$

$h = 1, 2, 3, \ldots n$

$dF = \delta\, dy$, δ = bone width

now, $$\sigma_x = \frac{E}{1-\nu^2}(\varepsilon_{xx} + \nu\,\varepsilon_{yy}) \qquad (7)$$

$$\sigma_y = \frac{E}{1-\nu^2}(\varepsilon_{yy} + \nu\,\varepsilon_{xx}) \quad (8), \qquad \tau_{xy} = \frac{E}{2(1+\nu)}\,\varepsilon_{xy} = \tau_{yx} \quad (9)$$

$$\varepsilon_{xx} = \frac{\partial u}{\partial x}, \qquad \varepsilon_{yy} = \frac{\partial v}{\partial y}, \qquad \varepsilon_{xy} = \frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} \quad (10)$$

Using equations 10 & 1 & 2 in eqs. 7, 8, & 9

$$\therefore \varepsilon_{xx} = \frac{\partial u}{\partial x} = \sum_{i=1}^{m} U_i'(x)\,\phi_i(y), \qquad \therefore \varepsilon_{yy} = \frac{\partial v}{\partial y} = \sum_{k=1}^{n} V_k(x)\,\psi_k'(y)$$

$$\therefore \varepsilon_{xy} = \frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} = \sum_{i=1}^{m} U_i(x)\,\phi_i'(y) + \sum_{k=1}^{n} V_k'(x)\,\psi_k(y)$$

$$\therefore \sigma_x = \frac{E}{1-\nu^2}\left(\sum_{i=1}^{m} U_i'\phi_i + \nu \sum_{k=1}^{n} V_k\,\psi_k'\right) \quad (11)$$

$$\therefore \sigma_y = \frac{E}{1-\nu^2}\left(\sum_{k=1}^{n} V_k\,\psi_k' + \nu \sum_{i=1}^{m} U_i'\phi_i\right) \quad (12)$$

$$\therefore \sigma_{xy} = \tau_{xy} = \frac{E}{2(1+\nu)}\left(\sum_{i=1}^{m} U_i\,\phi_i' + \sum_{k=1}^{n} V_k'\,\psi_k\right) \quad (13)$$

Using eqs. 11, 12, 13 in eqs. 5, the following equation is obtained:

$$\sum_{i=1}^{m} a_{ij}\,U_i'' - \frac{(1-\nu)}{2}\sum_{i=1}^{m} b_{ij}\,U_i + \sum_{k=1}^{n}\left(\nu t_{jk} - \frac{(1-\nu)}{2}c_{jk}\right)V_k' + \frac{(1-\nu^2)}{E}p_j = 0 \quad (14)$$

Using the same procedure in 6, we obtain:

$$-\sum_{i=1}^{m}\left(\nu t_{hi} - \frac{(1-\nu)}{2}c_{hi}\right)U_i' + \frac{1-\nu}{2}\sum_{k=1}^{n} r_{hk}\,V_k'' - \sum_{k=1}^{n} s_{hk}V_k + \frac{1-\nu^2}{E}q_h = 0 \quad (15)$$

In the above equation a_{ij}, b_{ij}, c_{jk}, t_{jk}, t_{hi}, c_{hi}, r_{hk} & s_{hk} is given by:

$$a_{ij} = \int \phi_j\,\phi_i\,dF = a_{ji}, \qquad r_{hk} = \int \psi_h\,\psi_k\,dF = r_{kh}, \qquad b_{ij} = \int \phi_j'\,\phi_i'\,dF = b_{ji}$$

$$s_{hk} = \int \psi_h'\,\psi_k'\,dF = s_{kh}, \qquad c_{jk} = \int \phi_j\,\psi_k'\,dF, \qquad c_{hi} = \int \psi_h\,\phi_i'\,dF,$$

$$t_{jk} = \int \phi_j\,\psi_k''\,dF \qquad t_{hi} = \int \psi_h'\,\phi_i\,dF \qquad \text{also,} \qquad p_j = \int p(x,y)\,\phi_j\,dy,$$

$$q_h = \int q(x,y)\,\psi_h\,dy$$

In the case of plane strains, the following have to be substituted for E & ν in equations 14 & 15, and in 7, 8, 9.

$$E_o = \frac{E_s}{1-\nu_s^2} \qquad \nu_o = \frac{\nu_s}{1-\nu_s}$$

E_s & ν_s are the modulus of elasticity & Poisson's ratio for the foundation materials.

From the differential equations 14 & 15, $U_i(x)$ & $V_k(x)$ can be determined. Thus the displacements of the elastic foundation $u(x,y)$ & $V(x,y)$ can be found from 1 & 2 & the stresses $\sigma_x, \sigma_y, \tau_{xy}$ from 7, 8 & 9. The accuracy of the solution can be increased by increasing the number of terms in eqs 1 & 2, but this increases the order of the differential equations 14 & 15 thus making them more difficult to solve.

With the general equations now in hand, we turn to the solution of the particular two layered material problem.

Consider an elastic material of thickness $H = h_1 + h_2$, undergoing plane deformations. The 2 layers have different moduli of elasticity and Poisson's ratios.

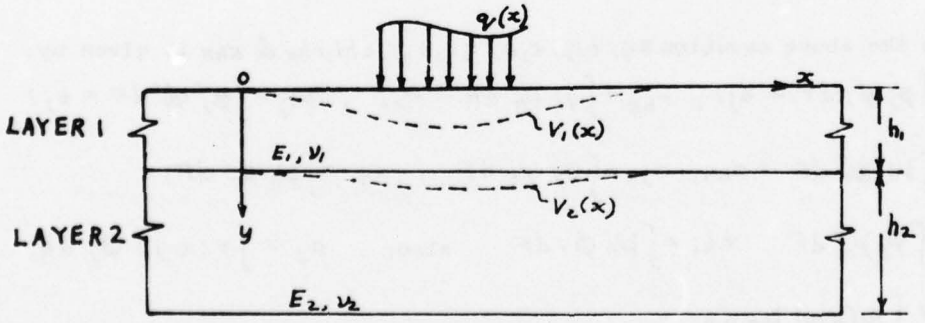


Fig. 3a.

$\therefore u(x,y) = 0$ also $v(x,y) = V_1(x)\,\psi_1(y) + V_2(x)\,\psi_2(y)$

$\psi_1(y)$ & $\psi_2(y)$ are functions of the transverse distribution of the displacements.
The functions $\psi_1(y)$, $\psi_2(y)$ are chosen according to the nature of the problem. If we assume that the normal stresses are not related to depth, then

at $0 \le y \le h_1$ $\quad \psi_1 = \dfrac{h_1 - y}{h_1}$, $\quad \psi_2 = \dfrac{y}{h_1}$

at $h_1 \le y \le H$ $\quad \psi_1 = 0$, $\quad \psi_2 = \dfrac{H - y}{h_2}$

Using Eq. 15 & substituting

$$u(x,y) = 0 \;,\; U_i(x) = 0 \;,\; q_2 = 0$$

$$\therefore \frac{1-\nu_1}{2}\left(r_{11}V_1'' + r_{12}V_2''\right) - \left(s_{11}V_1 + s_{12}V_2\right) + \frac{(1-\nu_1^2)}{E_1}q_1 = 0 \qquad (16)$$

for $h = 1$

$$\therefore \frac{E_1 r_{12}}{2(1-\nu_1)}V_1'' + \left[\frac{E_1}{2(1+\nu_1)}r_{22} + \frac{E_2}{2(1+\nu_2)}r_{22}^*\right]V_2'' - \frac{E_1}{1-\nu_1^2}S_{21}V_1$$

$$- \left[\frac{E_1}{1-\nu_1^2}S_{22} + \frac{E_2}{1-\nu_2^2}S_{22}^*\right]V_2 = 0 \qquad \text{for } h = 2 \qquad (17)$$

Here, $r_{11} = \int_0^{h_1}\psi_1^2\,dF = \dfrac{\delta h_1}{3}$, $r_{12} = \int_0^{h_1}\psi_1\psi_2\,dF = \dfrac{\delta h_1}{6}$, $r_{22} = \int_0^{h_1}\psi_2^2\,dF = \dfrac{\delta h_1}{3}$

$r_{22}^* = \int_{h_1}^{H}\psi_2^2\,dF = \dfrac{\delta h_2}{3}$, $s_{11} = \int_0^{h_1}(\psi_1')^2\,dF = \dfrac{\delta}{h_1}$, $s_{12} = \int_0^{h_1}\psi_1'\psi_2'\,dF = \dfrac{-\delta}{h_1}$

$s_{22} = \int_0^{h_1}(\psi_2')^2\,dF = \dfrac{\delta}{h_1}$, $s_{22} = \int_{h_1}^{H}(\psi_2')^2\,dF = \dfrac{\delta}{h_2}$ $\qquad (18)$

$E_1 = \dfrac{E_{1S}}{1-\nu_{1S}^2}$, $\nu_1 = \dfrac{\nu_{1S}}{1-\nu_{1S}}$, $E_2 = \dfrac{E_{2S}}{1-\nu_{2S}^2}$, $\nu_2 = \dfrac{\nu_{2S}}{1-\nu_{2S}}$

Where $E_{1S}, E_{2S}, \nu_{1S}, \nu_{2S}$ are the moduli of elasticity & Poisson's ratios of the first & second layers respectively.
Using eqs. 18, 16 & 17 reduce to:

$$2t_1V_1'' - k_1V_1 + t_1V_2'' + k_1V_2 + q = 0 \qquad (19)$$

$$t_1V_1'' + 2(t_1+t_2)V_2'' + k_1V_1 - (k_1+k_2)V_2 = 0 \qquad (20)$$

where $t_1 = \dfrac{E_1 h_1 \delta}{12(1+\nu_1)}$, $k_1 = \dfrac{E_1\delta}{h_1(1-\nu_1^2)}$, $t_2 = \dfrac{E_2 h_2 \delta}{12(1+\nu_2)}$, $k_2 = \dfrac{E_2\delta}{h_2(1-\nu_2^2)}$

The coefficients k_1 & k_2 determine the compressive strains of the upper & lower layers respectively, while t_1 & t_2 are the parameters defining shearing strains in the upper & lower layers respectively.

Eqs 19 & 20 are reduced to an identity by introducing a function F(x) such that:

$$V_1(x) = (k_1+k_2)\,F(x) - 2(t_1+t_2)\,F''(x) \quad , \quad V_2(x) = k_1 F(x) + t_1 F''(x) \qquad (21)$$

Substituting these in eq 19,

$$t_1(3t_1+4t_2)\,F^{4}(x) - 2(3t_1k_1 + t_1k_2 + t_2k_1)\,F''(x) + k_1k_2F(x) = q(x) \qquad (22)$$

The shear forces in layers one & two are

$$S_1(x) = \int_0^H J_{yx}\,\psi_1(y)\,dF \quad , \quad S_2(x) = \int_0^H J_{yx}\,\psi_2(y)\,dF \text{ respectively}$$

$$J_{yx} = \frac{E}{2(1+\nu)}\left[V_1'(x)\,\psi_1(y) + V_2'(x)\,\psi_2(y)\right]$$

at $0 \le y \le h_1$,
$$J_{yx} = \frac{E_1}{2(1+\nu_1)}\left[\left(\frac{h_1-y}{h_1}\right)V_1'(x) + V_2'(x)\left(\frac{y}{h_1}\right)\right]$$

at $h_1 \le y \le H$,
$$J_{yx} = \frac{E_2}{2(1+\nu_2)}\left[\left(\frac{H-y}{h_2}\right)V_2'(x)\right]$$

$$\therefore S_1(x) = t_1(2V_1'(x) + V_2'(x)) \qquad (23) \qquad S_2(x) = t_1V_1'(x) + 2(t_1+t_2)V_2'(x) \qquad (24)$$

Consider a rigid bone of length 2 L width & bearing on a layer of flesh and in turn pressing on a cushion.
$\psi(y)$ & $\psi_2(y)$ are assumed to vary linearly. It is assumed that the loading is symmetrical i.e. a concentrated force acts at the center of the beam.
Since the beam is rigid & loading is symmetrical, the deflection beneath the beam is a constant.

$$\therefore V_1(x) = C_0 \quad \text{in zone III}$$

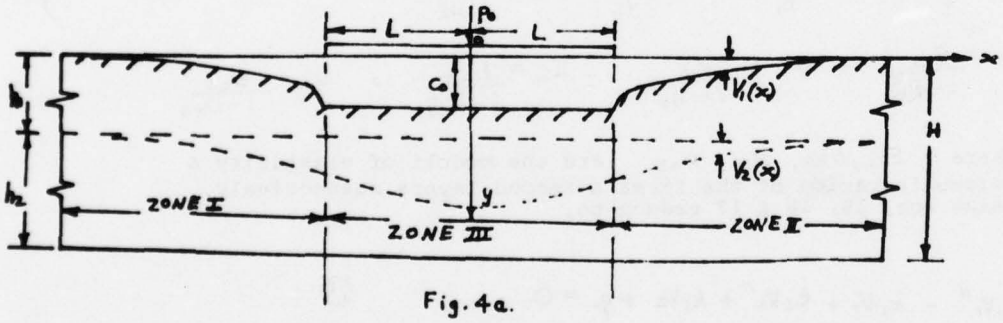


Fig. 4a.

Using eq 21:

$V_1(x) = (k_1+k_2)F(x) - 2(t_1+t_2)F''(x) = C_0$

∴ The general solution is:

$F(x) = C_1' Ch\beta x + C_2' Sh\beta x + \frac{C_0}{k_1+k_2}$ (25) where $\beta = \sqrt{\frac{k_1+k_2}{2(t_1+t_2)}}$

Solving eq 2 with $q(x) = 0$,

$F(x) = C_1 e^{\ell x} + C_2 e^{-\ell x} + C_3 e^{mx} + C_4 e^{-mx}$ where $\ell^2 = \frac{b+\sqrt{b^2-4ac}}{2a}$,

$m^2 = \frac{b-\sqrt{b^2-4ac}}{2a}$, $a = t_1(3t_1+4t_2)$, $b = 2(3t_1k_1 + t_1k_2 + t_2k_1)$, $c = k_1k_2$

$C_1 = C_3 = 0$ for V_1 & $V_2 = 0$ as $x \to \infty$

∴ $F(x) = C_2 e^{-\ell x} + C_4 e^{-mx}$ (26) ∴ $F''(x) = \ell^2 C_2 e^{-\ell x} + m^2 C_4 e^{-mx}$

∴ From eq 21, $V_1^{I}(x) = C_2\{(k_1+k_2) - 2(t_1+t_2)\ell^2\} e^{\ell(x+L)} + C_4\{(k_1+k_2) - 2(t_1+t_2)m^2\} e^{m(x+L)}$ (27)

for $x \le -L$

& $V_1^{II}(x) = C_2\{(k_1+k_2) - 2(t_1+t_2)\ell^2\} e^{-\ell(x-L)} + C_4\{(k_1+k_2) - 2(t_1+t_2)m^2\} e^{-m(x-L)}$ (28)

for $x \ge L$

$V_1^{III}(x) = C_0$ by definition

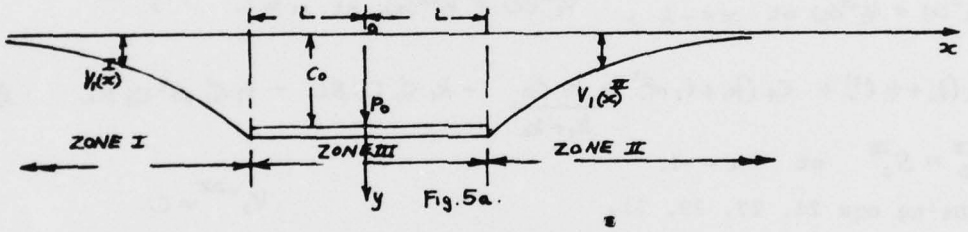


Fig. 5a.

From Eq 21,

$V_2^{I}(x) = C_2 e^{\ell(x+L)}(k_1 + t_1\ell^2) + C_4 e^{m(x+L)}(k_1 + t_1 m^2)$ (29) for $x \le -L$ ZONE I

& $V_2^{II}(x) = C_2 e^{-\ell(x-L)}(k_1 + t_1\ell^2) + C_4 e^{-m(x+L)}(k_1 + t_1 m^2)$ (30) for $x \ge L$ ZONE II

Using eq 25 in 21,

$V_2^{III}(x) = -k_1 C_1' Ch\beta x - t_1 C_1' \beta^2 Ch\beta x + \frac{k_1 C_0}{k_1+k_2}$ (31) $C_2' = 0$ as $V_2^{III}(x)_{x=L} = V_2^{III}(x)_{x=-L}$

C_1' is assumed to be negative.

From eq 23, shear force in ZONE III is

$S_{1b}^{III} = -t_1\{k_1 C_1' \beta Sh\beta L + t_1 C_1' \beta^3 Sh\beta L\}$ (32) $x = -L$

Shear for ZONE I is:

$$S_1^{I} = t_1\{2C_2\ell[(k_1+k_2) - 2(t_1+t_2)\ell^2] + 2C_4 m[(k_1+k_2) - 2(t_1+t_2)m^2] + (k_1+t_1\ell^2)C_2\ell + (k_1+t_1m^2)C_4 m\} \quad (33) \qquad x = -L$$

Reaction at bone end x = -L is:

$$Q_A = S_1^{I} - S_{1b}^{III} = Q_B$$

$$= t_1\{2C_2\ell[(k_1+k_2) - 2(t_1+t_2)\ell^2] + 2C_4 m[(k_1+k_2) - 2(t_1+t_2)m^2] + (k_1+t_1\ell^2)C_2\ell + (k_1+t_1m^2)C_4 m - t_1\{k_1 C_1'\beta Sh\beta L + t_1 C_1'\beta^3 Sh\beta L\} \quad (34)$$

∴ by principal of equilibrium of forces,

$$Q_A + Q_B + q \times 2L = P_0$$

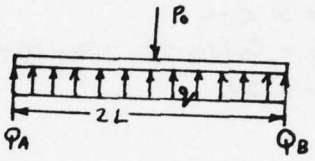
q is the uniform reaction under the beam per unit length of beam

Let $q = k_1 C_0$

We are assuming this reaction to be a constant throughout the length of the beam.

$$\therefore 2Q_A = P_0 - 2Lk_1C_0$$

$$\therefore Q_A = \frac{P_0 - 2Lk_1C_0}{2} \quad (35)$$



$V_2^{I}(x) = V_2^{III}(x)$ at $x = -L$, $V_2^{II}(x) = V_2^{III}(x)$ at $x = L$ Fig. 6a.

$$\therefore C_2(k_1+t_1\ell^2) + C_4(k_1+t_1m^2) = \frac{k_1C_0}{k_1+k_2} - k_1C_1'Ch\beta L - t_1C_1'\beta^2 Ch\beta L \quad (36)$$

$S_2^{I} = S_2^{III}$ at $x = -L$

Using eqs 24, 27, 29, 31, $V_1'^{III} = 0$

$$\{C_2\ell(k_1+t_1\ell^2) + C_4 m(k_1+t_1m^2)\}2(t_1+t_2) + t_1\{C_2\ell[(k_1+k_2) - 2(t_1+t_2)\ell^2] + C_4 m[(k_1+k_2) - 2(t_1+t_2)m^2]\} = 2(t_1+t_2)(\beta k_1 C_1' Sh\beta L + t_1 C_1'\beta^3 Sh\beta L) \quad (37)$$

$V_2'^{III}(x) = V_2'^{I}(x)$ at $x = -L$ $\qquad x = -L$

$$\therefore k_1 C_1'\beta Sh\beta L + t_1 C_1'\beta^3 Sh\beta L = C_2\ell(k_1+t_1\ell^2) + C_4 m(k_1+t_1m^2) \quad (38)$$

The constants C_0, C_2, C_4 & C_1 are evaluated using eqs. 35, 36, 37, & 38

Hence the stresses in the flesh is obtained by using eqs: 39, 40, 41, & 42.

$$\sigma_y = \frac{E_{15}}{1-\nu_{15}^2}\left[\frac{-C_0}{h_1} + \frac{1}{h_1}\left\{\frac{k_1C_0}{k_1+k_2} - k_1C_1'Ch\beta x - t_1C_1'\beta^2 Ch\beta x\right\}\right] \quad [39]$$

$0 \le x \le L$

$$J_{xy} = \frac{E_{1S}}{2(1+\nu_{1S})} \times \frac{y}{h_1}\left[-k_1 C_1' \beta \, Sh\beta x \; - t_1 C_1' \beta^3 \, Sh\beta x\right] \qquad 0 \leq x \leq L \qquad [40]$$

$$\sigma_y = \frac{E_{1S}}{1-\nu_{1S}^2}\left[\frac{-1}{h_1}\left\{C_2 e^{-\ell(x-L)}\left\{(k_1+k_2) - 2(t_1+t_2)\ell^2\right\} + C_4 e^{-m(x-L)}\left\{(k_1+k_2) - 2(t_1+t_2)m^2\right\}\right\}\right.$$

$$\left. + \frac{1}{h_1}\left\{C_2 e^{-\ell(x-L)}(k_1+t_1\ell^2) \; + C_4 e^{-m(x-L)}(k_1+t_1 m^2)\right\}\right], \; x \geq L \qquad [41]$$

$$J_{xy} = \frac{E_{1S}}{2(1+\nu_{1S})}\left[\frac{h_1-y}{h_1}\left\{C_2 \ell e^{-\ell(x-L)}\left\{(k_1+k_2) - 2(t_1+t_2)\ell^2\right\}\right.\right.$$

$$\left. + C_4 m e^{-m(x-L)}\left\{(k_1+k_2) - 2(t_1+t_2)m^2\right\}\right\}$$

$$\left. + \frac{y}{h_1}\left\{C_2 e^{-\ell(x-L)}\ell(k_1+t_1\ell^2) \; + C_4 e^{-m(x-L)} m (k_1+t_1 m^2)\right\}\right], \; x \geq L \qquad [42]$$

The stress acting in the y direction is σ_y. This is obtained from equations /39/ and /41/.

The solution of eqs. /39/ through /42/ was achieved in numerical form with an unsophisticated hand calculator (HP45). The results, for those conditions given in Fig. 1, are shown in Figs. 2, 3, and 4.

Bull. Prosth. Res., BPR 10-31, Spring 1979.

LOCOMOTION ASSISTANCE THROUGH CANE IMPULSE[a]

Leon Bennett, M.A.E.
Chief, Mobility Aids Laboratory
Veterans Administration Prosthetics Center
252 Seventh Avenue
New York, N.Y. 10001

Mary Patricia Murray, R.P.T., Ph. D.[b]
Director, Kinesiology Research Laboratory
Veterans Administration Medical Center
Wood, Wisconsin 53193

Eugene F. Murphy, Ph. D.
Director

Tamara T. Sowell, R.P.T., B.S.
Assistant to the Director
Office of Technology Transfer
Rehabilitative Engineering Research and Development Service
Veterans Administration
252 Seventh Avenue
New York, N.Y. 10001

ABSTRACT

The extent of locomotion assistance gained through cane usage by those with hip disorders is assayed. Employing as a standard the propulsive impulse delivered by each lower limb of a healthy young male, the cane is shown to supply about one-fifth the equivalent impulse, aside from other possible benefits. Full test values are given for nine handicapped subjects.

INTRODUCTION

Use of a cane is known to act in one or more planes to increase stability during locomotion, supply sensory information, reduce the

[a]Parts of this paper were presented at the Sixth International Symposium on External Control of Human Extremities, Dubrovnik, Yugoslavia, August 28, 1978–September 1, 1978 and published in Advances in External Control of Human Extremities, Yugoslav Committee for Electronics and Automation, ETAN, Belgrade, 1978 (pp. 315-324).

[b]This work was supported by the Rehabilitative Engineering Research and Development Service of the Veterans Administration and by United States Public Health Service Grant No. 13854 from the National Institute of Arthritis, Metabolism and Digestive Diseases.

loading of musculoskeletal structures, and contribute to the acceleration and braking requirements of bipedal locomotion. This study quantitates one aspect of cane use by computing the amplitude of the accelerative and braking cane impulses during locomotion for nine subjects with hip pain.

Materials and Methods

Nine men, all of whom had no disability other than severe pain in one hip resulting from degenerative joint disease and/or avascular necrosis, participated in the study. Their ages, heights and weights are given in Table 1. All of the men were experienced cane users, and each used his cane in the hand opposite the side of the pain. When walking without a cane, all subjects exhibited the pain-avoidance maneuvers characteristic of the antalgic limp associated with hip pain (1).

TABLE 1.—*Subject Physical Characteristics, Momentum, and Cane Impulse Results*

Subject	Age	Height (In)	Weight (Lbf)	Ave. Vel. (Ft/Sec)	Ave. Momentum (Lbf-Sec)	Cane Contact Time (Sec)	Cane Brake Impulse (Lbf-Sec)	Cane Accel. Impulse (Lbf-Sec)
1	44	70.5	176	2.60	14.2	0.85	0.39	0.59
2	69	67	185	2.70	15.5	0.[illegible]	0.11	1.13
3	60	66	223	1.53	10.6	1.55	1.05	3.86
4	76	67	145	2.70	12.2	0.75	0.11	1.00
5	43	74	172	3.39	18.1	0.69	2.[illegible]8	1.43
6	31	70	150	2.17	10.1	0.90	0.18	0.88
7	67	66	170	1.47	7.8	1.50	0.46	1.76
8	46	65.5	136	2.04	8.6	0.85	0.79	1.30
9	51	69.5	197	3.59	22.0	0.70	0.58	0.79

The cane force data reported in this study were obtained from an instrumented cane developed by Seireg, et al. (2), which measured the axial force as a function of time. The displacement patterns of the body and the cane shaft during walking were obtained with a previously described method of interrupted-light photography at the Wood Veterans Administration Medical Center, Wood, Wisconsin (3). For each subject, the following measurements were made: the amplitude of the axial force applied to the cane, the orientation of the cane in the sagittal plane throughout the period of cane contact, and the average velocity of the subject while walking with the cane. A typical example of a pattern of cane force versus time is shown in Figure 1 together with a plot of the fore-aft orientation angle of the cane shaft with the vertical during the same time period.

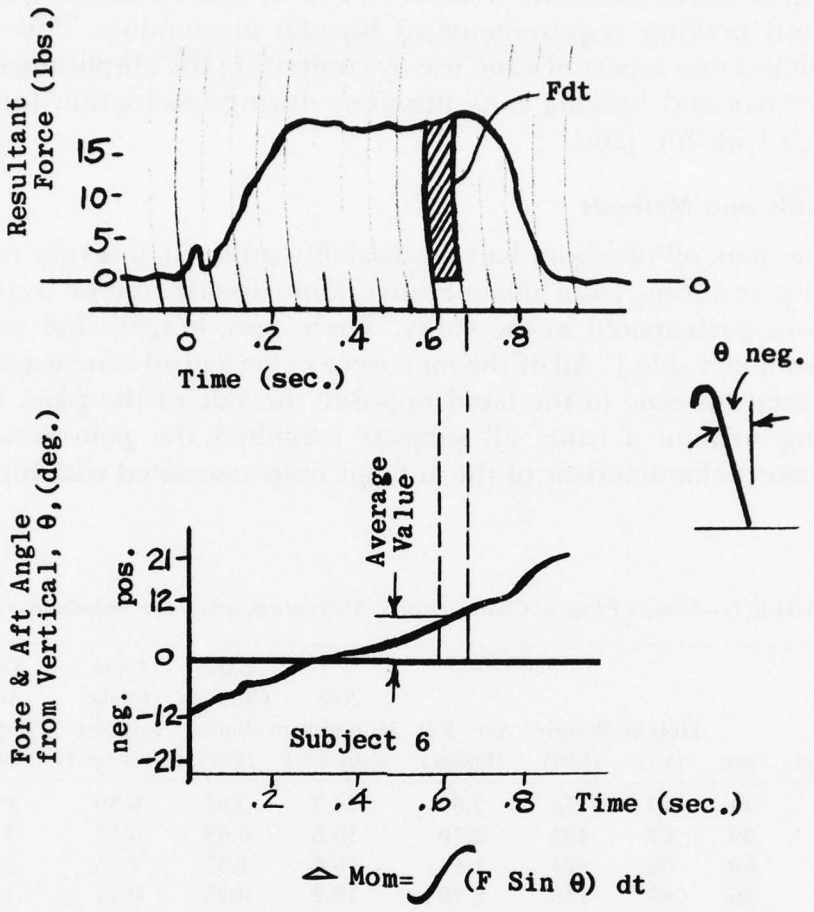


FIGURE 1.—Cane impulse computation (Data from M.P. Murray, Wood VA Medical Center, Wood, Wisconsin).

Computation of Braking and Accelerative Impulses

The average momentum of each subject during walking was calculated as Mom=wv/g where weight w in lbf divided by the acceleration of gravity g is the mass, and v is the subject's mean forward velocity. For example, if the value of 4.5 ft/sec is used as representative of the average forward velocity of normal young men (4), along with a weight estimate of 150 lbf, it may be shown that the corresponding momentum value is approximately 21 lbf-sec. Actually there are variations above and below the average momentum in each stance phase of walking because velocity varies rhythmically.

For the purpose of this study, the variation in momentum during the stance phase of a single limb is considered and this is diagramatically shown in Figure 2. At the instant of heel contact, a braking process is initiated in which the basic forward momentum is considerably reduced. The braking process continues until the leg is

substantially vertical, with the foot flat on the floor (5), and forward momentum is at a minimum. The ensuing push-off process increases momentum until toe-off when the entire initial momentum is restored. Thus, the basic momentum level is continuously altered as a function of time in approximately a sinusoidal pathway about the average value.

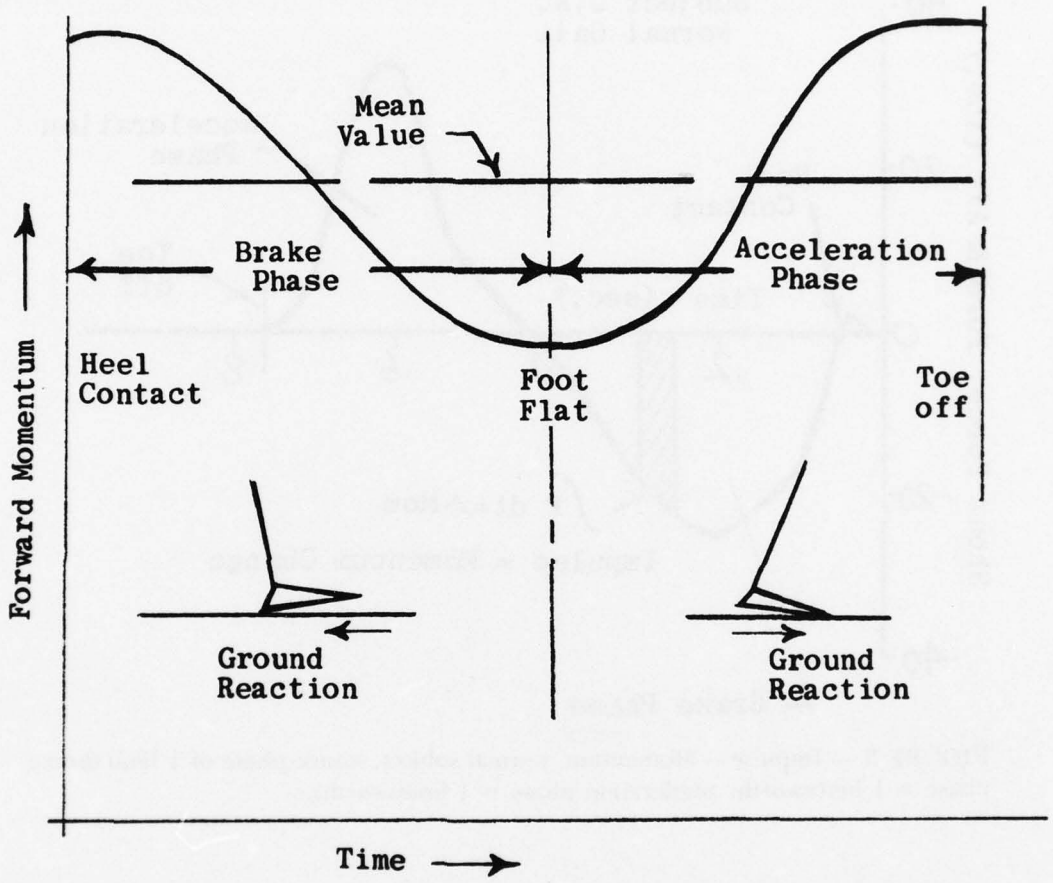


FIGURE 2.—Forward momentum—normal subject—stance phase of one limb. (The decrease from heel contact to foot flat is the result of 1 limbsworth of brake impulse; increase from foot flat to toe off is the result of 1 limbsworth of impulse during the acceleration phase—see page 42 for an explanation of the coined term "limbsworth.")

To compute the amplitude of the momentum wave resulting from the action transmitted through a single lower limb, the classic impulse-momentum relationship was used. The change in momentum (i.e., the net impulse) is given by the integral of the cane fore-and-aft shear force F with respect to time: $\Delta \text{Mom} = \int F dt$.

Figure 3 shows a force plate record of the fore-and-aft shear forces of a normal young man during the stance phase of locomotion (6), walking without a cane. These forces are used in calculating changes

in forward momentum. The initial or negative area phase of the record corresponds to the braking tendency following heel contact, and the positive area portion corresponds to the momentum increase developed in push-off.

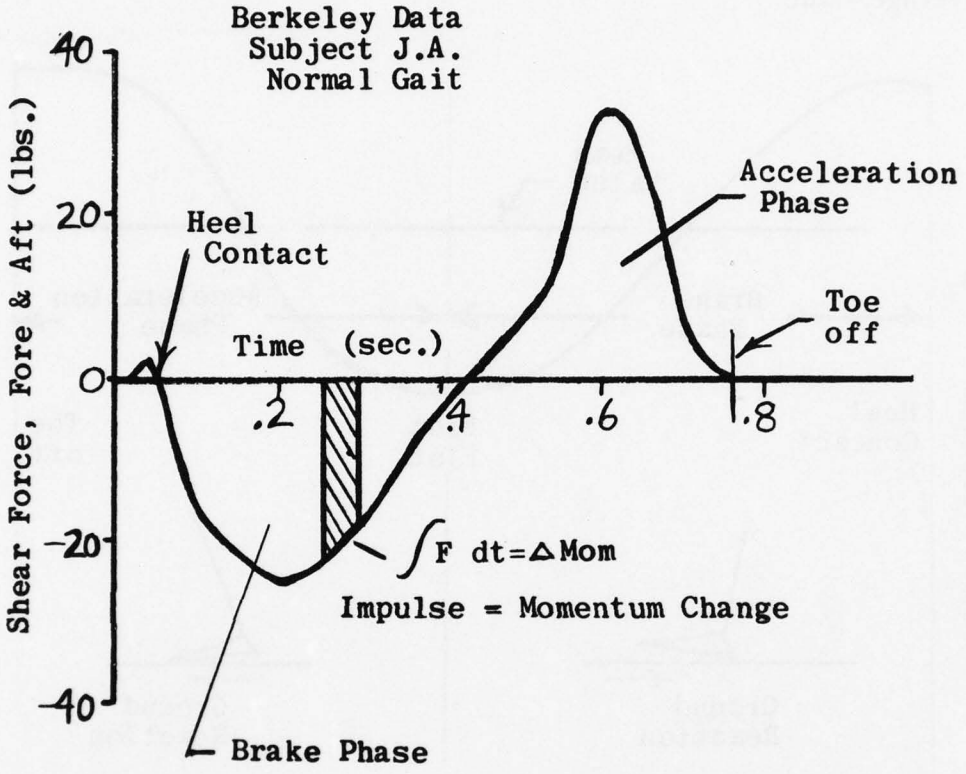


FIGURE 3. — Impulse — Momentum, normal subject, stance phase of 1 limb (brake phase = 1 limbsworth; acceleration phase = 1 limbsworth).

Analysis of the ground reactions of three normal subjects (6) by conventional graphical strip-integration procedures yielded an average value of 4.3 lbf-sec for the braking portion of the stance phase and 4.8 lbf-sec for the accelerating portion. As a practical measure a rough average value, 4.5 lbf-sec, will be used to represent the single lower limb impulse developed by normal young men in the course of the braking or accelerating phase of gait. The value 4.5 lbf-sec shall be called a "limbsworth" of impulse and shall be used as a basis for comparing cane output.

Cane impulse was computed by $\int F \sin \Theta \, dt$ through strip integration of the force-time curve. F is the cane resultant (axial) load, t is the time of ground contact and Θ is the fore-aft cane angle from the vertical. Positive and negative values of Θ indicate acceleration (positive) or brake (negative) phases of load transfer (Fig. 1). Correspond-

ingly, the decrease in momentum from heel contact to footflat (Fig. 2) is caused by the brake phase momentum represented by the area of the negative loop in Figure 3.

RESULTS

Table 1 presents individual data for average velocity, average momentum, cane contact time, and cane braking and accelerating impulses for the nine men with hip pain. The average cane braking impulse developed by the subjects was 0.66 lbf-sec or 14 percent of a limbsworth of impulse. For eight of the nine subjects the accelerative impulse was greater than the braking impulse. The accelerative impulses averaged 1.41 lbf-sec or 31 percent of a limbsworth of impulse. Neither the braking nor accelerative impulses correlated significantly with body weight. In Figure 4 each subject's braking and accelerating impulses are depicted in order of decreasing acceleration impulses, and compared to the amplitude of a single limbsworth of impulse.

DISCUSSION

The results reported in this study must be viewed in light of the limitations of the technique. This study measured the direct contribution to forward momentum produced by the cane and only by the cane. The alterations of the normal momentum interchange in the body segments of the subjects because they were using the canes are not considered. Any comprehensive study of momentum would require full data from two force plates and measurements of instantaneous velocity of the subject, as well as data on the cane orientation and forces applied to the cane.

In order to achieve a reasonably constant-velocity gait, normal subjects must generate or transmit approximately equal amounts of accelerating and braking impulses. The cane's function is unlike that of a lower limb during gait, in that the cane user has a free choice as regards the orientation of the cane and the magnitude of the impulse imparted to the cane. In principle, the cane can be used to generate an upward acceleration only, an accelerating impulse only, or a braking impulse only, (or any combination of such impulses) and the cane user may still maintain a constant-velocity gait. In practice, since the cane subserves the needs and deficits of the user, he trades-off many variables such as pain, high energy cost, and instability to arrive at a combination he deems optimal. Without seeking to evaluate the wisdom of each such solution, this paper addresses itself to the propulsive and restraint functions of cane use.

The cane users in this study chose to develop an average of 14 percent of a limbsworth of braking impulse and 31 percent of a

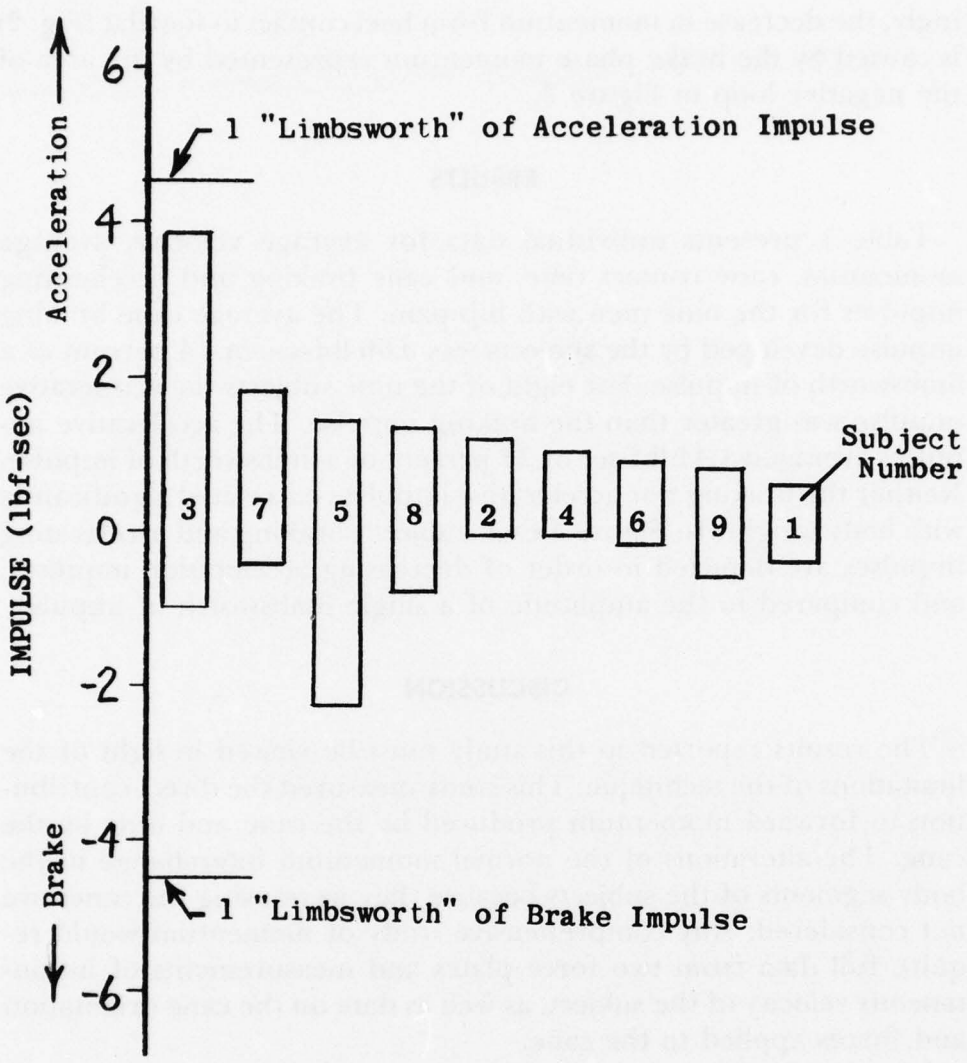


FIGURE 4.—Cane impulse results.

limbsworth of accelerating impulse. Thus, the accelerating aspect of cane use in these patients with hip pain was employed more extensively than the brake aspect by an amplitude of approximately two to one. (The "limbsworth" unit is based on the action of the lower limbs of healthy young men in accelerating and braking during gait; most of the subjects in this study were middle-aged or elderly.) It is apparent that the use of a cane for propulsion requires a great deal of muscular effort from the upper limb of the user. Thus, the use of a cane for propulsion is seen as highly significant to the user; were it not so, he would not make the effort.

Cane use subserves more than propulsion and restraining functions (7). Since the cane angles of the subjects in this study never exceeded 20 deg from the vertical, it is apparent that a large part of their

applied force was also effective in decreasing the vertical load on the painful hip. As shown in Figure 5, the cane is acting at a long lever arm so that even a modest force can produce a large moment at the hip joint center. This would reduce the amount of force required from hip abductor musculature, which normally contracts during single-limb support to control the descent of the pelvis on the unsupported side (1, 7-11). The load relief derived in this fashion can make walking tolerable to many who would otherwise be forced into wheelchairs.

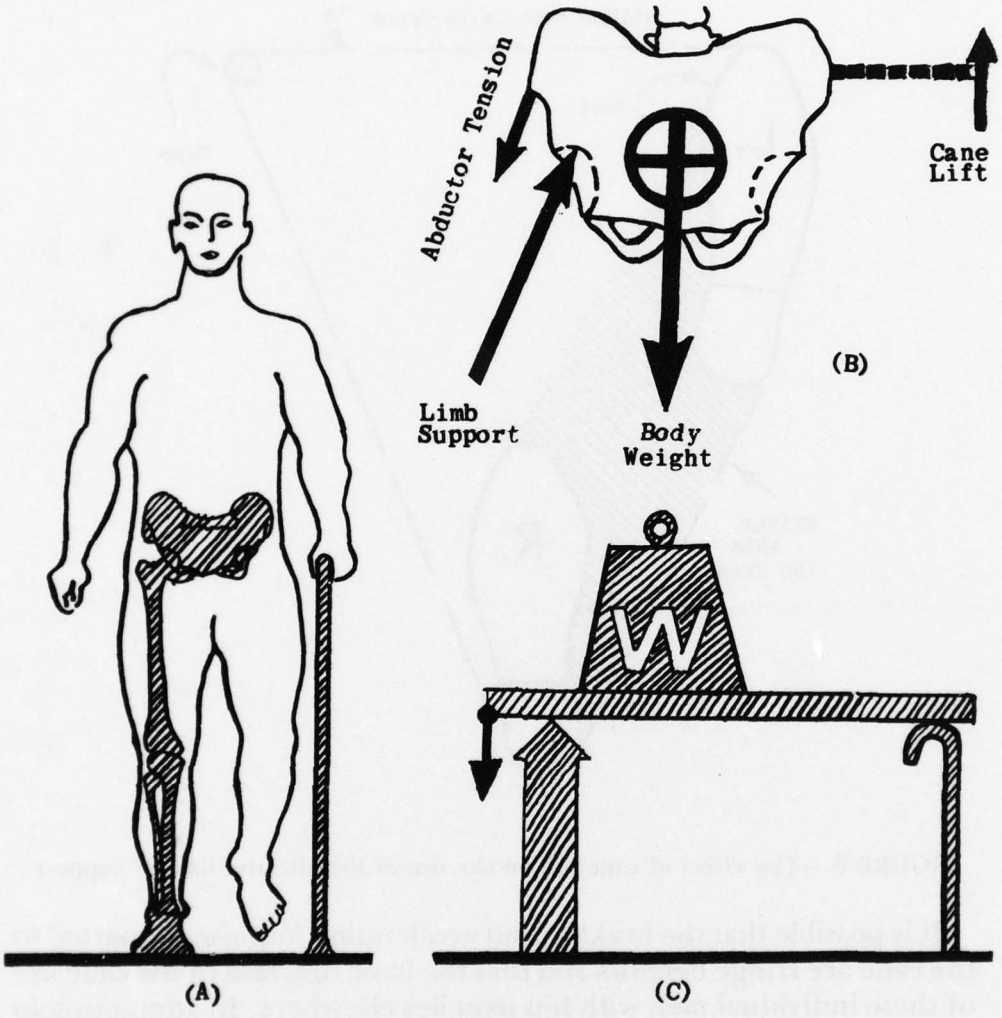


FIGURE 5.—The cane's effect in reducing the load on the contralateral limb is suggested by this set of schematic drawings. Note in (B) and (C) the manner in which the hip abductor muscle normally plays an important role in controlling the descent of the pelvis on the unsupported side. When a cane supports one end of the pelvic lever (via the arm and the structure of the trunk) the cane's support allows the pelvis to be maintained essentially horizontal even if the hip abductor contribution is small or absent.

An additional benefit of cane use is improved stability. The size of the effective base of support is increased during single-limb-support (Fig. 5) and double-limb-support as well (Fig. 6). As long as the action line of the center of gravity of the ambulator is within the bounds of the base area, the ambulator is geometrically stable. Clinically, this increase in stability is particularly useful to persons with diminished ability to recover balance, and to disabled persons negotiating inclines or moving about in high winds.

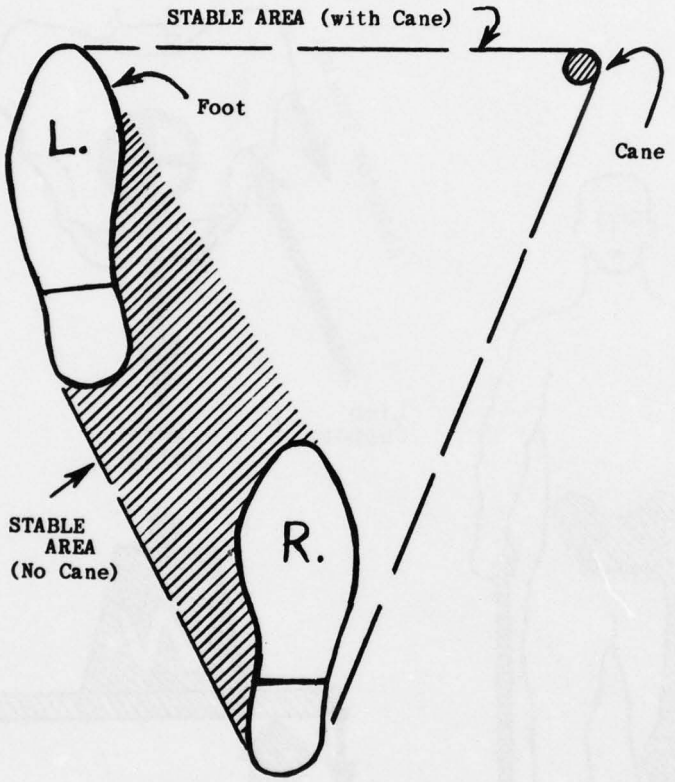


FIGURE 6.—The effect of cane use on the size of the effective base of support.

It is possible that the braking and accelerating impulses imparted to the cane are fringe benefits and that the basic function of the cane use of these individual men with hip pain lies elsewhere. In attempting to relieve pain or increase stability, the user may inadvertently apply the cane to the floor at angles near the beginning and end of the stance phase which contribute to restraint and propulsion. It can only be said that those suffering hip pain do use a cane in a manner suitable to aid restraint and propulsion, and that the personal cost in terms of muscular effort is high.

CONCLUSIONS

Nine experienced cane users who had hip pain resulting from degenerative joint disease or avascular necrosis were tested to determine the braking and accelerative impulses imparted to their canes during walking. It was learned that:

1. The average cane braking impulse developed in gait was 0.66 lbf-sec, or 14 percent of the equivalent value generated by a normal lower limb (14 percent of a limbsworth). Braking impulse values ranged from 0.11 lbf-sec to 2.28 lbf-sec.

2. The average cane acceleration impulse developed in gait was 1.41 lbf-sec, or 31 percent of the equivalent value generated by a normal lower limb. Accelerating impulse values ranged from 0.59 lbf-sec to 3.86 lbf-sec, and the accelerating impulses were higher than the braking impulses in eight of the nine subjects.

REFERENCES

1. Murray, M.P., D.R. Gore, and B.H. Clarkson: Walking Patterns of Patients with Unilateral Hip Pain Due to Osteo-Arthritis and Avascular Necrosis. J. Bone and Joint Surg., 53-A (2): 259-273, 1971.
2. Seireg, A.H., M.P. Murray, and R.C. Scholz: Method for Recording the Time, Magnitude and Orientation of Forces Applied to Walking Sticks. Amer. J. Phys. Med., 47(6):307-314, 1968.
3. Murray, M.P., A.B. Drought, and R.C. Kory: Walking Patterns of Normal Men. J. of Bone and Joint Surg., 46-A(2):335-360, 1964.
4. Drillis, R.J.: The Influence of Aging on the Kinematics of Gait. The Geriatric Amputee, Publication 919, CPRD, NAS-NRC, Wash., D.C., 1961.
5. Drillis, R.: Objective Recording and Biomechanics of Pathological Gait. Annals of the N.Y. Acad. of Sc., 74, Art. 1, p. 103, Sept. 30, 1958.
6. Eberhart, H.D., et al.: Fundamental Studies of Human Locomotion and Other Information Relating to Design of Artificial Limbs, University of California, Berkeley, 1, Fig. 8-11, (Floor Reactions on the Foot—Northrop Footplates) 1947.
7. Murray, M.P., A.H. Seireg, and R.C. Scholz: A Survey of the Time, Magnitude and Orientation of Forces Applied to Walking Sticks by Disabled Men. Amer. J. Phys. Med. 48(1):1-13, 1969.
8. Blount, W.P.: Don't Throw Away the Cane. J. Bone and Joint Surg., 38-A(3):695-708, 1956.
9. Rydell, N.: Biomechanics of the Hip Joint. Clin. Orthop. and Rel. Res., 92:6-15, May, 1973.
10. Pauwels, Friedrich: Der Schenkelhalsbruch Ein Mechanisches Problem. Stuttgart, Ferdinand Enke, 1935.
11. Murphy, E.F.: Some Notes on Canes and Cane Tips. Bull. Prosth. Res., 10-14, 65-67, Fall 1965.

Bull. Prosth. Res., BPR 10-31, Spring 1979.

VETERANS ADMINISTRATION REHABILITATIVE ENGINEERING RESEARCH AND DEVELOPMENT SERVICE PROGRAMS

PROSTHETICS

Edited by

Eugene F. Murphy, Ph. D., Director
Office of Technology Transfer
Veterans Administration
252 Seventh Avenue
New York, N.Y. 10001

Rehabilitative Engineering Research and Development Center
Palo Alto VA Medical Center
3801 Miranda Avenue
Palo Alto, California 94304
Larry J. Leifer, Ph. D.

Introduction

On May 5th, 1978, Veterans Administration officials announced the establishment of a Rehabilitative Engineering Research and Development Center at their Palo Alto Medical Center. The RER&D Center is a cooperative venture, between faculty and students of the Stanford University School of Engineering and VA Medical Center staff. The new center is charged with bringing advanced engineering science and technology to the direct benefit of severely disabled persons. The research and development program of this center is now in a formative phase. In large measure it reflects areas of excellence already available at Stanford, at the Palo Alto VA Medical Center, and in the surrounding research and industrial community. The organizational structure and philosophy of the new RER&D Center are designed to make maximal use of this innovative environment. The center accepts responsibility for testing new developments in the clinical environment and for subsequent distribution of proven devices

through commercialization. These ideas and examples of early activity in the RER&D Center are detailed within this report.

Goal

The RER&D Center will bring advanced engineering science and technology to the direct benefit of disabled persons. The following subgoals have been identified:

1. Perform basic research needed to understand physical disability and define benefits to be gained through development of new devices for the disabled. Emphasis is placed in the areas of:
   a. orthopedic biomechanics;
   b. neuromuscular systems; and
   c. sensory communications.
2. Design and develop manufacturable devices for the disabled. Emphasis is placed upon the following methods:
   a. computer simulation of disability and corrective devices;
   b. microelectronic and microcomputer applications;
   c. comprehensive product design to deal with the physical, emotional, and intellectual needs of the disabled;
3. Assure the availability of new devices for the disabled:
   a. evaluate new devices in clinical and outpatient environments;
   b. train physicians, therapists, and patients in the use and maintenance of rehabilitative devices;
   c. promote understanding and widespread adoption of worthy devices;

Key Resources

The RER&D Center is located within an area of longstanding biomedical research and development. Within a 10-mile radius one has access to the following institutional resources:

1. Palo Alto Veterans Administration Medical Center,
2. Stanford University School of Engineering,
3. Stanford University School of Medicine,
4. Children's Hospital at Stanford,
5. Stanford Research Institute,
6. NASA Ames Research Center,
7. Santa Clara Valley Medical Center, and
8. Santa Clara Valley industry.

Biomedical engineering research and development has been active in this community for many years. A clinically oriented rehabilitation engineering center has existed at the Children's Hospital for the last 5 yrs. It has often been possible to make minor changes in ongoing biomedical studies such that the work is better tuned to the pragmatic issue of delivering new technology and devices to the disabled. Experienced research and development personnel have responded to

the challenge. The center itself is directed by experienced researchers whose academic mission is the training of research-oriented physicians and engineers at the M.D., Ph. D., M.S., and B.S. levels. Student involvement at all levels brings vigor and freshness into an area of desperate need. The complexity of many rehabilitation problems makes their solution people-intensive and thus expensive. Student participation can reduce rehabilitation engineering costs while providing an excellent training experience.

Approach

Operation of the RER&D Center is based upon the following principles:

1. Management by catalysis;
2. Consumer involvement;
3. Student involvement; and
4. Vertical integration—
   a. basic research
   b. applied research
   c. development

   z. basic care

Management by catalysis is based upon the premise that most of the ingredients needed for a successful operation are already present in the environment. The management function then becomes one of identifying goals and facilitating the accomplishment of objectives by funding and motivating individuals who will perform the tasks required. This approach is feasible because of the breadth and depth of personnel available within the resource set of the RER&D Center. The spirit of the program is entrepreneurial without the dollar profit motive. Ideas will be developed to the point of practicality. New devices will be brought to the market place.

Consumer involvement in the research and design/development program of the center is assured. The center is located directly on the VA Medical Center grounds adjacent to the Spinal Cord Injury Service. Disabled persons are consulted during the initial needs assessment phase of a new project. They are then part of the design/development team. The center has staff members and students who are themselves disabled. While the disabled person may not always be the expert regarding his/her own disability, he/she is the potential user of an improved aid. Our concern for user acceptance is focused on a series of projects to be done with behavioral scientists. For example, in the Robotic Aids Project, behavioral studies are being planned to coincide with each phase of hardware and software development. These studies are designed to keep us informed about real user

needs, capabilities, and expectations.

Student involvement is present at all levels of performance. Bachelor of Science candidates participate in projects for which locally available technology provides useful solutions. A typical project lasts 5-10 weeks. Both needs assessment and prototype development have been successfully performed by these engineering and product design students. Master of Science degree candidates are expected to use state-of-the-art technology. These students typically work on one problem for 9 months and have time to get well acquainted with the appropriate technology. They are expected to interact regularly with prospective clinical users during device development as well as device testing. Doctor of Philosophy and Doctor of Medicine candidates will spend 2 to 4 yrs focused on a problem of basic significance to our understanding of disability and the means of treatment. These individuals are expected to provide new information and to extend the boundaries of our knowledge.

The concept of vertical integration is borrowed from contemporary corporate management methodology. The term refers to the presence, within one organizational unit, of the means for performing research, design/development, manufacture, and distribution of a product. Within the RER&D Center this approach refers to the performance of basic research needed to define device specifications, the design/development of pre-production prototypes, the evaluation of prototypes on a routine inhouse basis, the contracted manufacture of limited numbers of samples of seemingly worthy devices, and the distribution of these devices under contract and VA prescription. Key personnel work with a new device from the time of its conception to the time of its distribution and assure that persons expected to use or prescribe the device are properly trained.

Structure

Relationships between the PAVAMC RER&D Center and other organizational units are presented in Figure 1. The command hierarchy is simple and vertical. The advisory mechanisms are multiple and require some explanation. At the Palo Alto Veterans Administration Medical Center level there are two Dean's Committees which will advise the Medical Center Director regarding research and professional personnel in the RER&D Center. One Dean's Committee is chaired by the dean of the Stanford Medical School and oversees operation of the affiliateship between the VA and the Medical School. The chairpersons of departments related to rehabilitation are members of this committee. The second Dean's Committee is to be chaired by the dean of the Stanford School of Engineering. Key investigators and chairpersons will be committee members. An affiliation between the School of Engineering and the VA is being developed in parallel

with that of the Medical School Affiliation. These committees are not concerned with routine operational factors of either the PAVAMC or the RER&D Center.

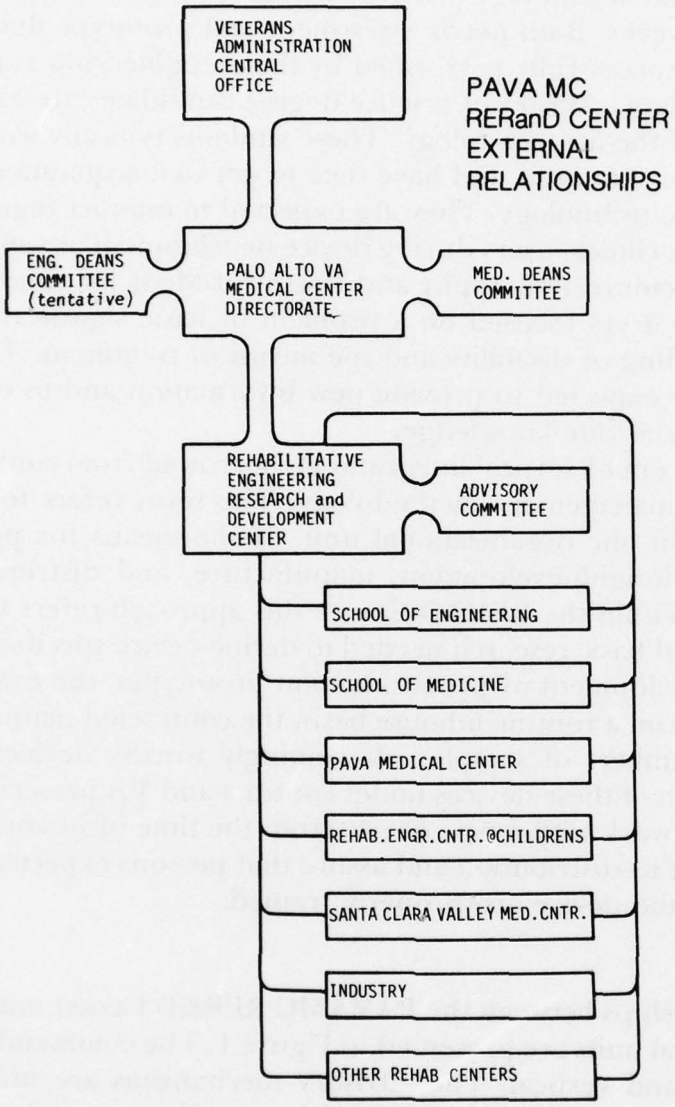


FIGURE 1.—RER&D Center External Relations. The command hierarchy of the RER&D Center is simple and vertical. The Center Directorate reports to the Palo Alto Veterans Administration Medical Center Director and his Associate Chief of Staff (ACOS). The Medical Center Director communicates directly with the Rehabilitative Engineering Research and Development Program Director in the Veterans Administration Central Office (VACO). Refer to the text regarding advisory roles played by Deans of the Schools of Medicine and Engineering. The RER&D Center maintains an advisory board of its own for coordination with local industry and medical units. The series of organizational units tied into the RER&D loop are principal elements in the center's resource pool.

Internal structure of the RER&D Center is shown in Figure 2. This graphic representation is designed to convey two important principles:

1. Interaction, and
2. Fluidity.

As an interaction matrix, the columns of Figure 2 represent academic lines of investigation which are emphasized in the center program:

1. Orthopaedic Biomechanics;
2. Neuromuscular Systems; and
3. Sensory Communications.

Each of these areas is supervised by a senior investigator with a regular faculty appointment at Stanford, typically in engineering and/or medicine. Approximately one third of the center staff are allocated to each investigational category. Individual staff positions are further defined according to their function:

1. Basic Research;
2. Design and Development; or
3. Training, Evaluation and Promotion.

Each of these RER&D Center functions is supervised by a senior investigator with a regular faculty appointment at Stanford. Note that personnel in each category of investigation must deal with each performance function. This arrangement explicitly indicates our intention that persons working within any given academic discipline are expected to interact with, and participate in, all phases of a project from basic research goal definition through training of persons expected to use our products.

Interaction is further defined to mean that persons working within any given area are expected to interact with people and projects in adjacent nodes of the matrix. For example, a design/development engineer can be expected to spend 60 percent of his/her effort on an orthopedic biomechanics device, 30 percent on instrumentation for a new research program in neuromuscular systems analysis, and 10 percent on the training of physical therapists who are using an exercise device developed last year. In a similar sense, a senior investigator may spend 75 percent of his/her time on basic research associated with development of new sensory prostheses, a 15 percent effort may be directed towards overseeing the development of a prosthesis, and a 10 percent effort may be invested in training physicians responsible for prescribing sensory prostheses. For completeness, a staff physical therapist can be expected to spend 60 percent of his/her time on patient treatment with a new device or methodology developed in the center, a 25 percent effort may be directed towards a clinical research/evaluation project, and a 15 percent effort participating in basic orthopedic biomechanics research.

Fluidity is represented by the open form of each matrix node. It is

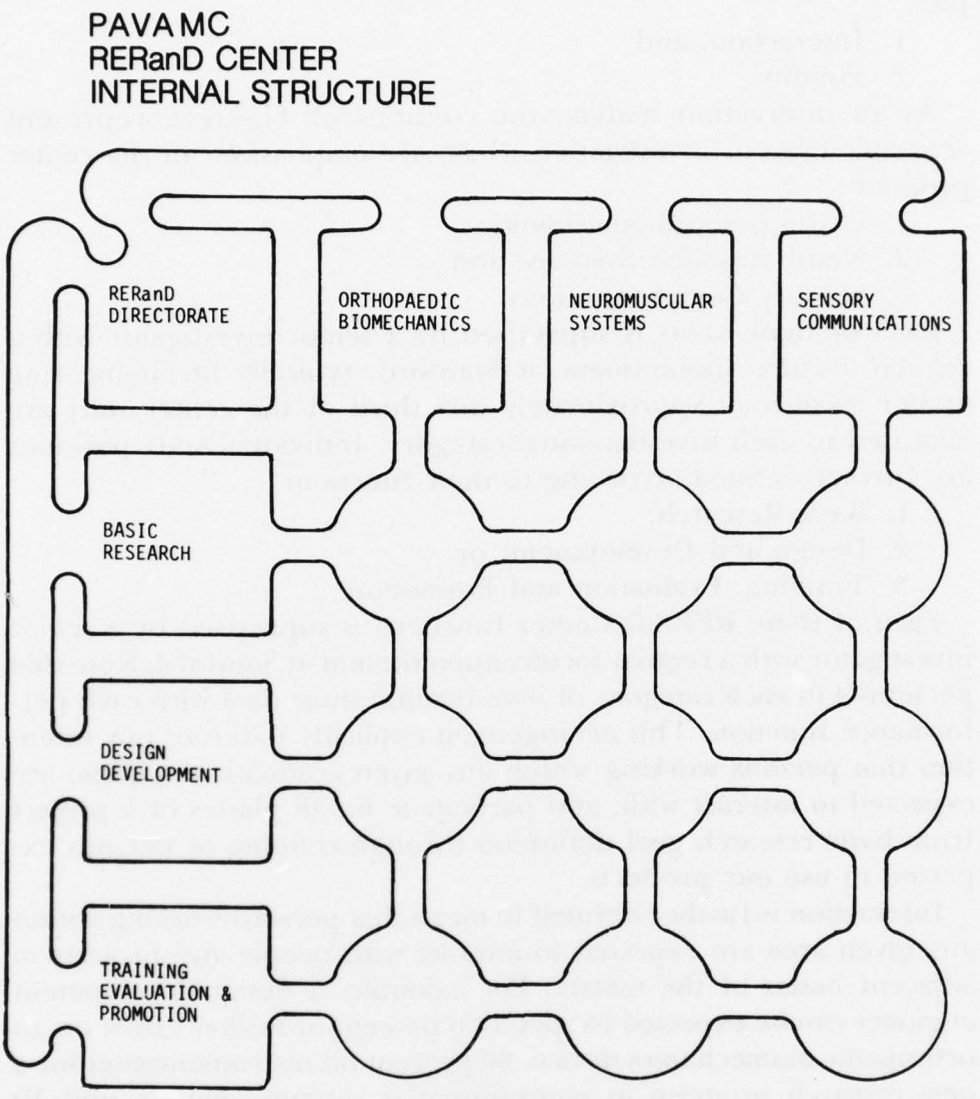


FIGURE 2.—RER&D Center Internal Structure. The center is composed of seven administrative functions. These are arranged as an interaction matrix to emphasize the degree to which interactions could and should exist in daily operations. Three columns identify the areas of investigation mandated for the RER&D program. These are academic disciplines and will be supervised by senior staff with faculty appointments at Stanford University. Three rows define the primary functions of the center. Performance of these functions is supervised by senior staff with faculty appointments at Stanford. Interaction between individuals is strongly encouraged. Flexible allocation of individual effort amongst related nodes in the diagram is expected. The RER&D directorate is responsible for overall coordination of goals and resources.

important to center function that individuals be free to move from one project and function to another as circumstances demand. With this freedom comes the responsibility to participate in areas and functions which may be of secondary interest at any one moment but require the energy and expertise of a particular individual. As a correllary, it is acceptable that individuals alter their areas of involvement after fair trial. It is expected that 60 percent or more of each person's effort will be placed within one node at a given time. The remaining percentage would not be divided amongst more than three other nodes. The guiding principle here is that clear priorities must exist for one's various commitments. The first priority task must get more than half of one's effort. At the other extreme, a commitment of less than 10 percent becomes diminishingly small in the world of hours-per-week.

Basic Research and Development

Six major research and development proposals have been submitted to the Veterans Administration Central Office (VACO) for funding. These proposals have been tailored to stated goals of the Rehabilitative Engineering Research and Development Program. In each case, 3 to 5 yr of work have been proposed. We have chosen to focus our efforts on difficult problems, especially those which would seem to benefit most from the application of advanced technology. This set of proposals does not represent the full range of activity planned for the center. These and forthcoming proposals must be co-investigated by interdisciplinary engineering Ph. D./M.D. teams. Each new member of the center research staff is expected to develop his/her own line of investigation and to seek funding specific to those objectives via the Research and Development Merit Review process. Projects of this type are expected to be our primary product.

Preliminary feasibility studies are being funded out of the center's operating budget and typically involve MS and Ph. D. candidates who assess the value of proposed work from the points of view of benefit to the disabled and validity as a thesis topic. A brief description of seed-funded proposals (1 through 4 in Table 1) will follow. Titles and authorship of all submitted proposals are listed in Table 1. Student feasibility studies are described in the Student Project Section.

1. Robotic Aids

Persons who are mentally alert but have a severe physical disability, need to control their physical environment independent of continuous assistance by other people. It is proposed that robotic arms such as the Unimation Model-250 Electric Arm can be used by the severely disabled in such a way as to render practical assistance in the performance of daily living tasks which now require the continuous pres-

TABLE 1.—*Major Research and Development Proposal Titles*

SU = Stanford University Faculty Position
VA = Veterans Administration Staff Position
SRI = Stanford Research Institute Staff Position

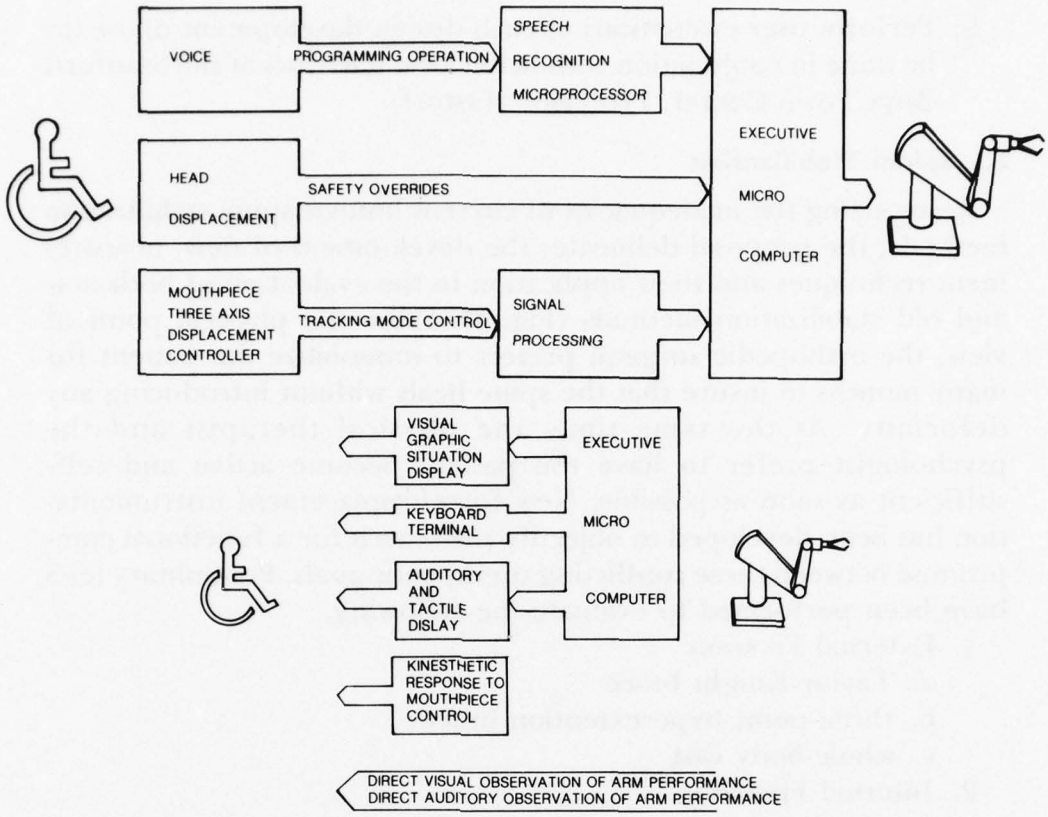
1. Development of Robotic Aids for the Severely Disabled
   1.1 Larry Leifer, Ph.D., responsible engineer (SU, VA)
   1.2 Inder Perkash, M.D., responsible physician (SU,VA)
2. Internal and External Stabilization of the Disrupted Dorsal Lumbar Spine
   2.1 Robert Piziali, Ph.D., responsible engineer (SU,VA)
   2.2 Donald Nagel, M.D., responsible physician (SU)
   2.3 Inder Perkash, M.D., sponsoring physician (SU,VA)
3. New Methods of Peripheral Nerve Repair and Assessment of Function
   3.1 Larry Leifer, Ph.D., responsible engineer (SU,VA)
   3.2 Vincent Hentz, M.D., responsible physician (SU,VA)
4. Development of a Personal Information System for the Visually Impaired
   4.1 John Linvill, Ph.D., responsible engineer (SU)
   4.2 Greg Goodrich, Ph.D., responsible psychologist (VA)
5. Needs Assessment Regarding Telecommunications and the Spinal Cord Injury Patient
   5.1 Blair Burgess, Ph.D., responsible engineer (SRI)
   5.2 Inder Perkash, M.D., responsible physician (SU,VA)
6. New Instrumentation for the Study of Pressure Sores, Their Etiology and Prevention
   6.1 James Angell, Ph.D., responsible engineer (SU)
   6.2 Lars Vistnes, M.D., responsible physician (SU,VA)

ence of a nursing aid. The proposal details plans for the development of four modes of interaction between the user and the robotic aid (Fig. 3). These include the following:

1. Voice command of discrete functions and execution of preprogrammed tasks;
2. General purpose keyboard input terminal;
3. Mechanical switches for power and failsafe features; and
4. Analog control of arm/hand tracking tasks which are roughly equivalent to flying.

Given an updated version of the Unimate Arm and its microcomputer controller, the proposal deals with:

1. Investigation of alternative voice-command hierarchies;
2. Development of an analogue controller suitable for use by high-level quadriplegics;
3. Development of a microcomputer network capable of coordinating arm control, voice recognition, program preparation, information retrieval, analogue control and safety supervision;
4. Development strategies and instrumentation for a "Smart Hand" (i.e., sensory feedback, computer reflexes, "decisions," etc.) to extend the capability of the present robotic aid;



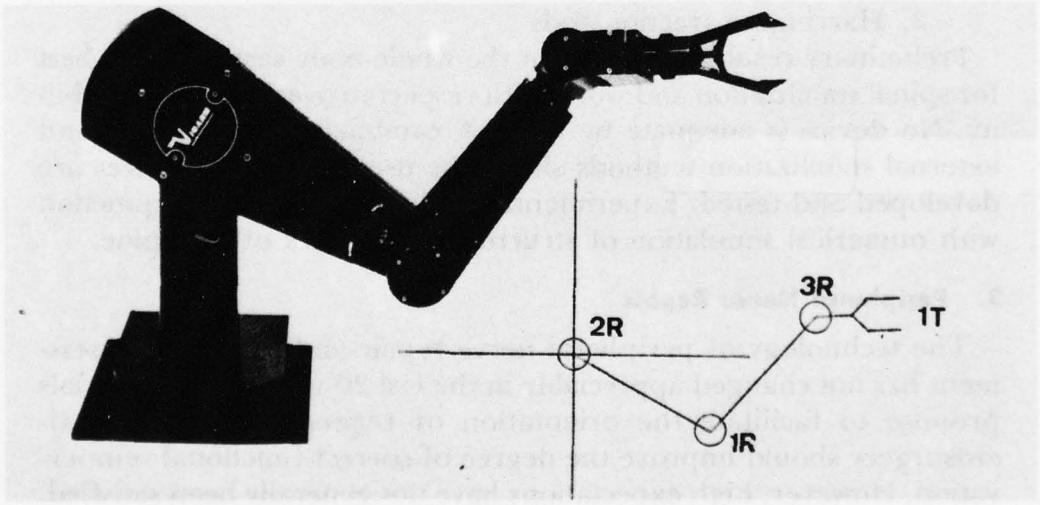


FIGURE 3.—Development of a Robotic Aid for the Severely Disabled. Initial studies have begun to determine the feasibility of using an industrial automation manipulator to provide severely disabled persons with some degree of physical control over their environment. The principal command modes are illustrated in Figure (3a). The various paths available for informing the user about manipulator performance are shown in Figure (3b). The arm and its degrees of manipulative freedom are presented in Figure (3c). This is the Unimation Model-250 Electromechanical Arm designed by Victor Scheinman. The project is led by: Larry Leifer, Ph.D., responsible engineer, and Inder Perkash, M.D., responsible physician

5. Perform user evaluations of each design/development phase (to be done in conjunction with behavioral scientists at the Stanford Boys Town Center, Professor Hastorf).

2. Spinal Stabilization

Recognizing the inadequacies of current lumbar spine stabilization methods, the proposal delineates the development of new measurement techniques and their application to the evaluation of both new and old stabilization methods (Fig. 4). From the physical point of view, the orthopedic surgeon prefers to immobilize the patient for many months to insure that the spine heals without introducing any deformity. At the same time, the physical therapist and the psychologist prefer to have the patient become active and self-sufficient as soon as possible. New force/displacement instrumentation has been developed to objectify the search for a functional compromise between these conflicting therapeutic goals. Preliminary tests have been performed to evaluate the following.

1. External Fixation
   a. Taylor-Knight brace
   b. three-point hyperextention brace
   c. whole-body cast
2. Internal Fixation
   1. wire loops
   2. Harrington traction rods

Preliminary results indicate that the whole-body cast is clearly best for spinal stabilization and worst with respect to overly limiting mobility. No device is adequate by itself. A combination of internal and external stabilization methods should be used until new devices are developed and tested. Experimental studies continue in conjunction with numerical simulation of structural properties of the spine.

3. Peripheral Nerve Repair

The technology of peripheral nerve repair and functional assessment has not changed appreciably in the last 20 years. New materials promise to facilitate the orientation of regenerating fibers. Microsurgery should improve the degree of correct functional reinnervation. However, high expectations have not generally been satisfied. In part this has been due to the lack of sensitive non-invasive techniques for the measurement of axonal function. Basic studies have been proposed to compare alternative repair techniques, using the following new assessment methods:

1. Quantification of the monophasic compound action potential—an invasive method;

2. Estimation of the distribution of axonal conduction velocities from the compound action potential without knowledge of single

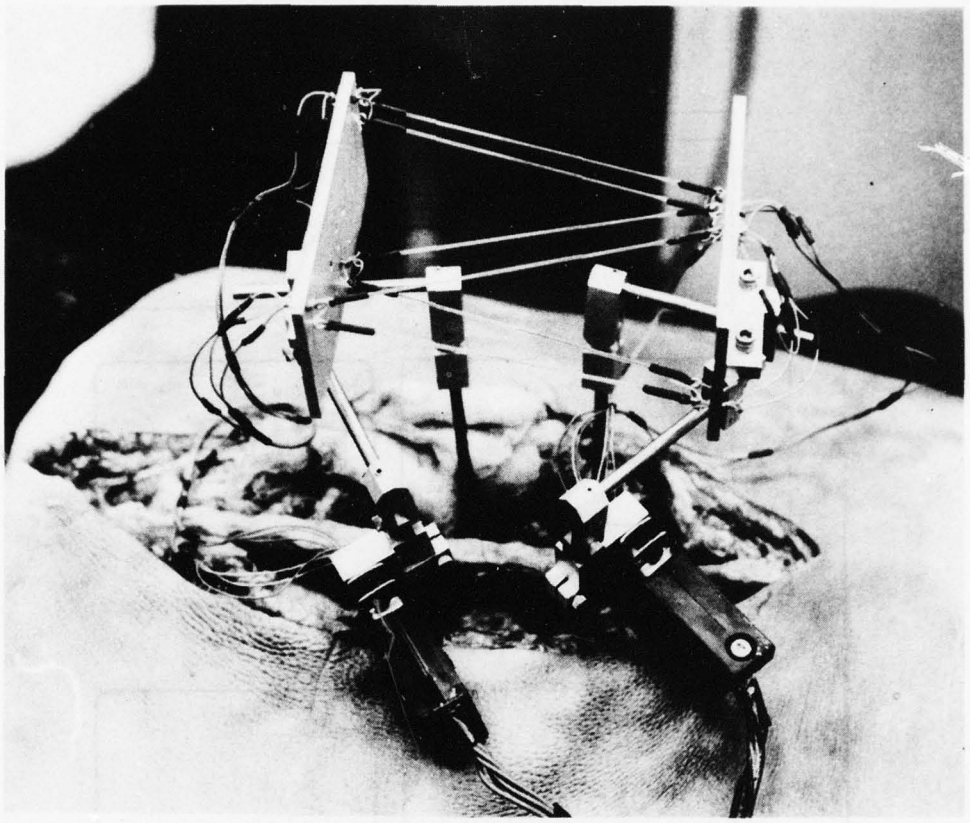


FIGURE 4.—Instrumentation to Measure the Effectiveness of Various Dorsal Lumbar Spine Stabilization Methods. A new force/displacement transducer has been developed to objectify the search for more effective ways to stabilize the disrupted dorsal lumbar spine. The device is shown being used to evaluate alternative stabilization methods based on carefully controlled human cadaver studies. The project is lead by Robert Piziali, Ph. D., responsible engineer, Donald Nagel, M.D., responsible physician, and Inder Perkash, M.D., sponsoring physician.

fiber action potential properties—a non-invasive method; and

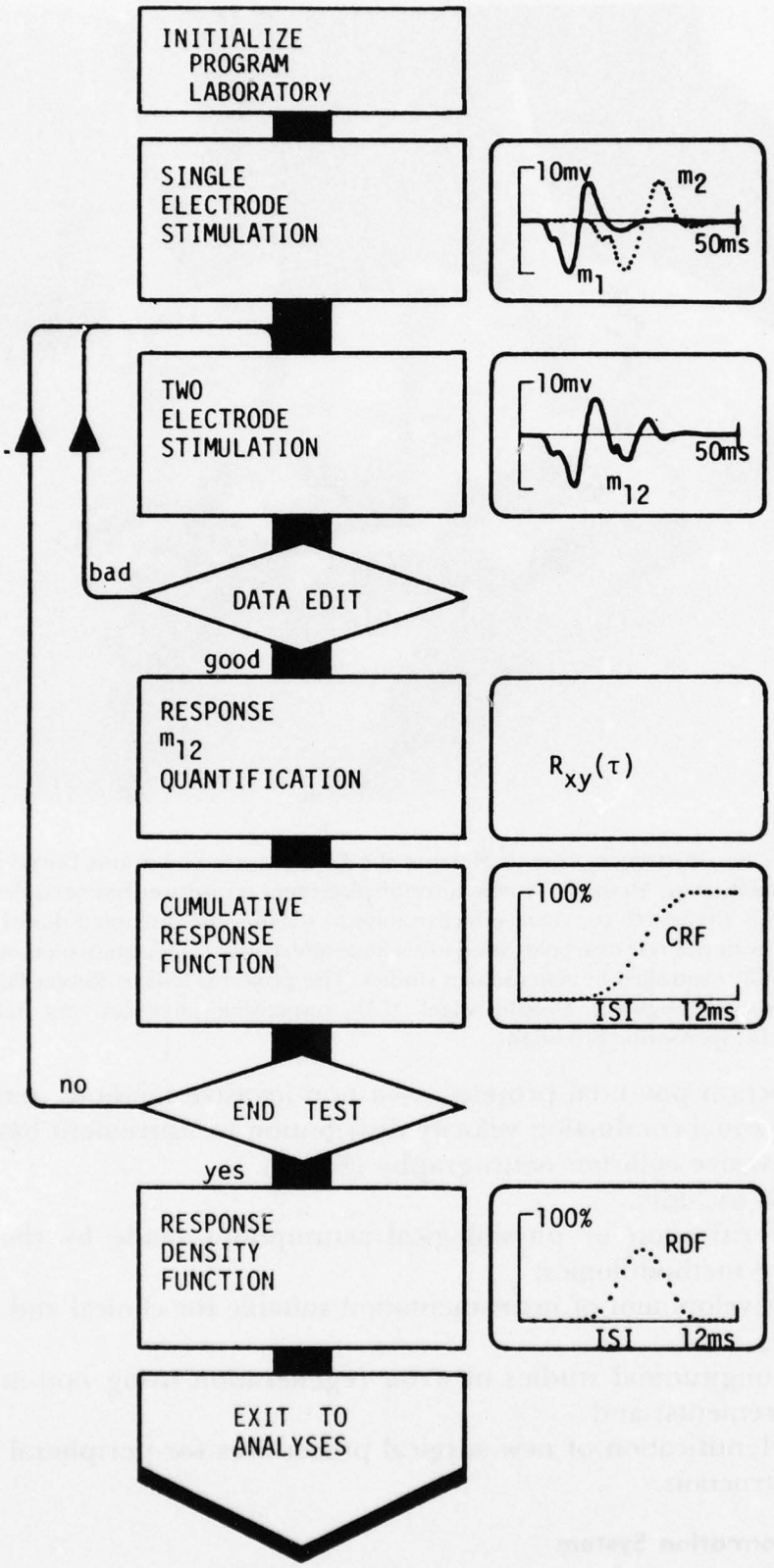
3. Axonal conduction velocity distribution measurement based on non-invasive collision neurography (Fig. 5).

Goals include:

1. Verification of physiological assumptions made by the non-invasive methodologies;
2. Development of instrumentation suitable for clinical and surgical use;
3. Longitudinal studies of axon regeneration using non-invasive measurements; and
4. Identification of new surgical procedures for peripheral nerve reconstruction.

4. Information System

Visually impaired persons are severely disadvantaged with respect


INITIALIZE PROGRAM LABORATORY
SINGLE ELECTRODE STIMULATION
10mv
m_2
50ms
m_1
TWO ELECTRODE STIMULATION
10mv
50ms
m_{12}
bad
DATA EDIT
good
RESPONSE m_{12} QUANTIFICATION
$R_{xy}(\tau)$
CUMULATIVE RESPONSE FUNCTION
100%
CRF
ISI 12ms
no
END TEST
yes
RESPONSE DENSITY FUNCTION
100%
RDF
ISI 12ms
EXIT TO ANALYSES

to personal information storage and retrieval. This situation handicaps them in the pursuit of educational, professional, and recreational goals. It is proposed that an advanced, but affordable, microcomputer system can be developed to fulfill the following information manipulation needs:

1. Text processing (input and editing);
2. Data storage and retrieval;
3. Computer programming;
4. Telecommunications usage; and
5. Note-taking (remote from the work station).

The key to accomplishment of these goals lies in the interface between a user and his/her microcomputer system (Fig. 6). Fortunately the information processing power of the computer can do much to reformat visually displayed information, such as the newspaper, into forms more useful to the visually impaired. Importantly, information generated by the user can also be translated into a form useful to the sighted. In this way the user can remain within the normal working environment of the sighted.

Basic research must be done to define the structure of an operating system appropriate to these goals. Development work will investigate the following major components of the system:

1. Input devices and protocols;
2. Information processing, storage, and retrieval; and
3. Output devices and protocols—
   a. for the visually impaired, and
   b. for the sighted.

Greg Fowler, a blind Ph. D. candidate in electrical engineering at Stanford, is now using a large computer facility to simulate alternative features for subsequent microcomputer systems. Greg does the computer programing with a standard display terminal and Optacon reader. He is supervising the installation of a voice output system, and will be responsible for programing it as an alternative output mode which might be useful to both sighted and visually impaired users.

FIGURE 5.—Assessment of Peripheral Motor Nerve Function Based upon Collision Neurography. New methods of peripheral nerve function assessment are being used to evaluate alternate nerve reconstruction techniques. One of these assessment methods is illustrated here. The approach is based on the use of noninvasive electrical stimulation of the peripheral nerve (typically at the wrist and just above the elbow). The time interval between paired stimulii is varied and the electrical response of the innervated muscles is quantified such that a minicomputer can be used to reconstruct the distribution of motor axon conduction velocities present in the nerve. Other assessment techniques are being used to measure sensory nerve function. The project is led by Larry Leifer, Ph. D., responsible engineer, and Vincent Hentz, M.D., responsible physician.



FIGURE 6.—Development of a Personal Information System for the Visually Impaired. Blind graduate student, Greg Fowler, is shown using an Optacon to read directly from a computer display terminal. He is currently performing simulation studies to determine the specifications for devices and programs which will allow visually impaired persons to use and maintain a complete personal information system. The information system is projected to be built on current microcomputer technology and is intended to allow its user to perform workstation tasks equivalent to those performed by sighted persons at rather standard desks. The system will include a portable unit with which the user can take notes and then include these notes in his/her office information base. This project is led by John Linvill, Ph. D., responsible engineer, and Greg Goodrich, Ph. D., responsible psychologist.

Student Pilot Project examples

Tables 2 and 3 list the student projects which have in some measure been supported by the RER&D program at Stanford. These projects are highly exploratory. Academic goals have first priority. But, these hardworking students can and do make an important contribution to the center's development program. A Bachelor's degree candidate will, typically, work a minimum of 12 hours per week. Five weeks are spent on need definition (60 hr minimum). Ten weeks are then spent on the design and development of a working prototype (120 hr, minimum). Engineering design Master's degree candidates spend a minimum of 16 hours per week on the project for 36 weeks and typically work in groups of three. Product design Master's degree candidates invest at least 24 hours per week for 36 weeks and typically work alone with outside consultants. A three member team will con-

TABLE 2.—*Student Pilot Projects in Academic Year '77-'78*

(BS) = Bachelor of Science Candidate
(MS) = Master of Science Candidate
(MFA) = Master of Fine Arts Candidate

1. A Kitchen Storage System for Paraplegics, by David Lima (MS)
2. A Modular Seating and Mobility System for the Severely Disabled, by Jonathan Flamm (MFA), Figure 7
3. Two-Handled Eating Utensils, by Gregory Shaw (MS), Figure 8
4. Servo Controlled Arm Exerciser for Spasticity, by Peter Axelson (BS), Ken Allen (MS), and Tom Woo (MS), Figure 9
5. Quadriplegic Reacher, by Joni Bessler (BS), Figure 10
6. Quadriplegic Reacher, by David Uken (BS), Figure 10
7. A Multiple Dose Pill Packager for Drug Consumption Control, by Carl Stern (BS), Tamiko Thiel (BS), and William Shriver (BS)
8. An Electronic Games Table for Quadriplegics, by James Holmes (BS)
9. Music Synthesizer Interface for the Physically Disabled, by Peter Aschenbrenner (BS),
10. A Personalized Communication Device for a Stroke-Impaired Adult, by Peggy Christianson (BS)

TABLE 3.—*Student Pilot Projects in Academic Year '78-'79*

(BS) = Bachelor of Science Candidate
(MS) = Master of Science Candidate
(MFA) = Master of Fine Arts Candidate

1. Robotic Arm Controller for Quadriplegics, by Paul Justl (MS), Steve Tipton (MS)
2. Upper-Limb Ergometer for Chair and Bed Bound Individuals, by Mike Barker (MS), Jim Dornbusch (MS), Humberto Rincon (MS)
3. Body Pressure Distribution Visualization and Measurement, by Tom Kinney (MS), John Kirby (MS), Mary Springhorn (MS)
4. A Walk-in Bathing System for Elderly Individuals, by BoFat Chan (MFA)
5. Memory Rehabilitation Training System, by William Shriver (MS)
6. A Wheeled Mobility Aid for the Institutional Environment, by David Willis (MFA)
7. A "Smart Hand" for the Unimate 250 Robotic Arm, by Rickson Sun (MS)
8. Additional projects are pending

tribute well over 1728 man/woman hours to the project at no cost to the VA. However, VA support for materials and fabrication costs is vital to allow students to get beyond paper studies into the building of real devices and the evaluation of these devices in the hospital and outpatient environment. Both undergraduate and graduate students are expected to:

1. identify the user;
2. identify the need;
3. define a specific problem within the need area;

4. Define the performance criteria;
5. Design alternative solutions;
6. Develop one design into a working prototype; and
7. Obtain user evaluation of the prototype; and
8. Document the project.

All project work is based upon the cardinal questions:

1. WHO needs something?
2. WHAT do they need?
3. WHY?
4. HOW should it work?
5. HOW does it work?

Of course some of these projects do better than others. Four successful examples are given here to illustrate the potential of student involvment in the RER & D program.

A modular seating system was developed during the academic year '77-'78 (Fig. 7). Work was performed by Jonathan Flamm, product design master's degree candidate, with technical assistance from Wallace Motloch of the Children's Hospital at Stanford. The seating system was designed to satisfy the postural stabilization requirements of palsied and spinal cord injured individuals. The initial prototype was scaled to children. The project was undertaken because secondary disabilities are incurred by these people if correct posture is not maintained. Current seating systems were found to be costly (over $1500 per fitting), structurally inadequate, complex, and/or aesthetically unacceptable. The desired solution was seen to require modularity for cost reduction, postural flexibility, and cleanliness. The prototype accomplished the design objectives and won first prize at the 6th International Conference on Devices for the Disabled, Student Design Competition (Houston, June '78). Subsequent to graduation, Mr. Flamm was employed by the Everest and Jennings Corporation to further develop the design for the consumer market.

A two-handled eating utensil was developed during the academic year '77-'78 (Fig. 8). Work was performed by Gregory Shaw, product design master's degree candidate. The eating device was designed to facilitate independent self-feeding for individuals lacking sufficient unilateral motor control to accomplish the task. The project was undertaken following a survey of existing eating assist devices which indicated that these devices were either unuseful and/or expensive and cumbersome.

The guiding principle of the design approach was simplicity. The prototype was based on the observation that when two hands were used to eat a sandwich, the degree of control was far better than when eating with single-handed utensils. The two-handled spoon/knife



FIGURE 7.—A Modular Seating System for the Severely Disabled. This seating system was designed to satisfy the postural stabilization requirements of palsied and spinal cord injured individuals. The initial design studies have been scaled to children, and much of the work was done in conjunction with staff of the Children's Hospital at Stanford Rehabilitation Engineering Center. The modular shell and cushion system promises to reduce manufacturing costs while providing increased postural flexibility and easy cleaning. Jonathan Flamm, Master of Fine Arts candidate, was the responsible designer. He received first prize in a student design competition at the 6th International Conference on Devices for the Disabled (Houston, June '78).

achieved the design objective with deceptive simplicity and won second prize in the student design competition at the 6th International Conference on Devices for the Disabled (Houston, June '78). The design is now being refined for production.

A servocontrolled arm exerciser was developed during the academic

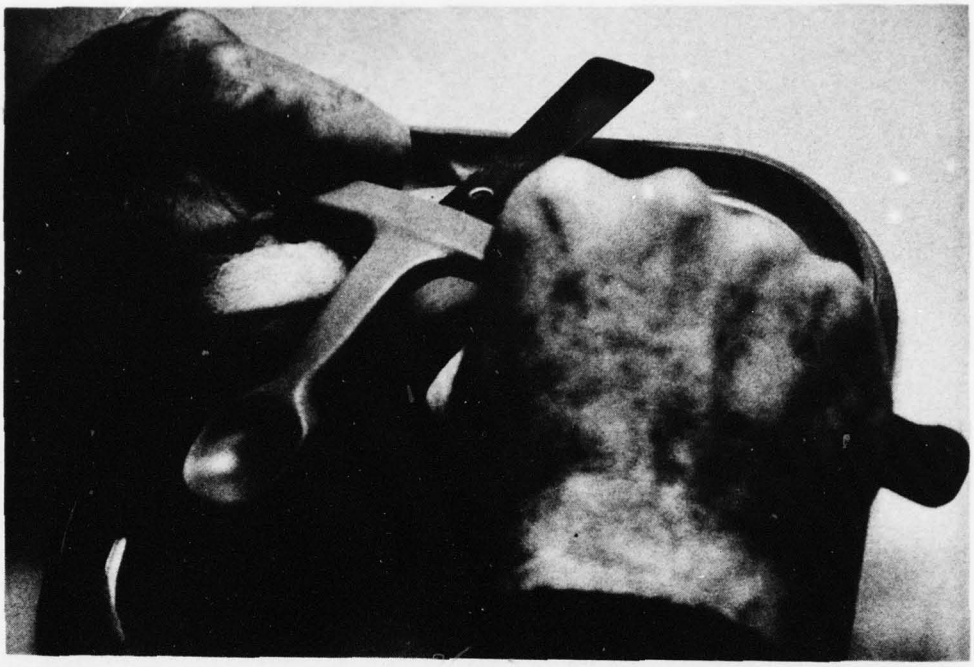


FIGURE 8.—A Two Handled Eating Utensil for Persons with Upper Limb Movement Disorders. This simple eating device was designed to facilitate independent self feeding for individuals unable to accomplish the task with traditional hand-held utensils. The design is based upon an observation that sandwiches, held with two hands, could be eaten by many persons who could not manage spoons and forks. The device is made of a soft plastic to avoid injury. Greg Shaw, Master of Science in Product Design candidate, was the responsible designer. His project won second prize in a student design competition at the 6th International Conference on Devices for the Disabled (Houston, June '78).

year '77-'78 by three members of an engineering design master's project team; Peter Axelson, Ken Allen, and Tom Woo (Fig. 9). The device was designed in collaboration with Dr. S. Berrol of the Santa Clara Valley Medical Center and Dr. I. Perkash of the PAVAMC Spinal Cord Injury Service. The project was undertaken in order to provide a tireless exerciser which would be sensitive to the patient's capability. The device is programed such that loads experienced by the user are always at the threshold where maximum learning and conditioning are accomplished. No equivalent device was found in a survey of existing technology. The prototype accomplished its primary functional objectives. The device is now undergoing clinical trials under the direction of Dr. Berrol.

Two body-powered reachers were developed during the spring of '78 by product design undergraduates, Joni Bessler and David Uken (Fig. 10). Their need-finding study indicated that most quadriplegics with residual upper-limb function were unable to retrieve objects from the

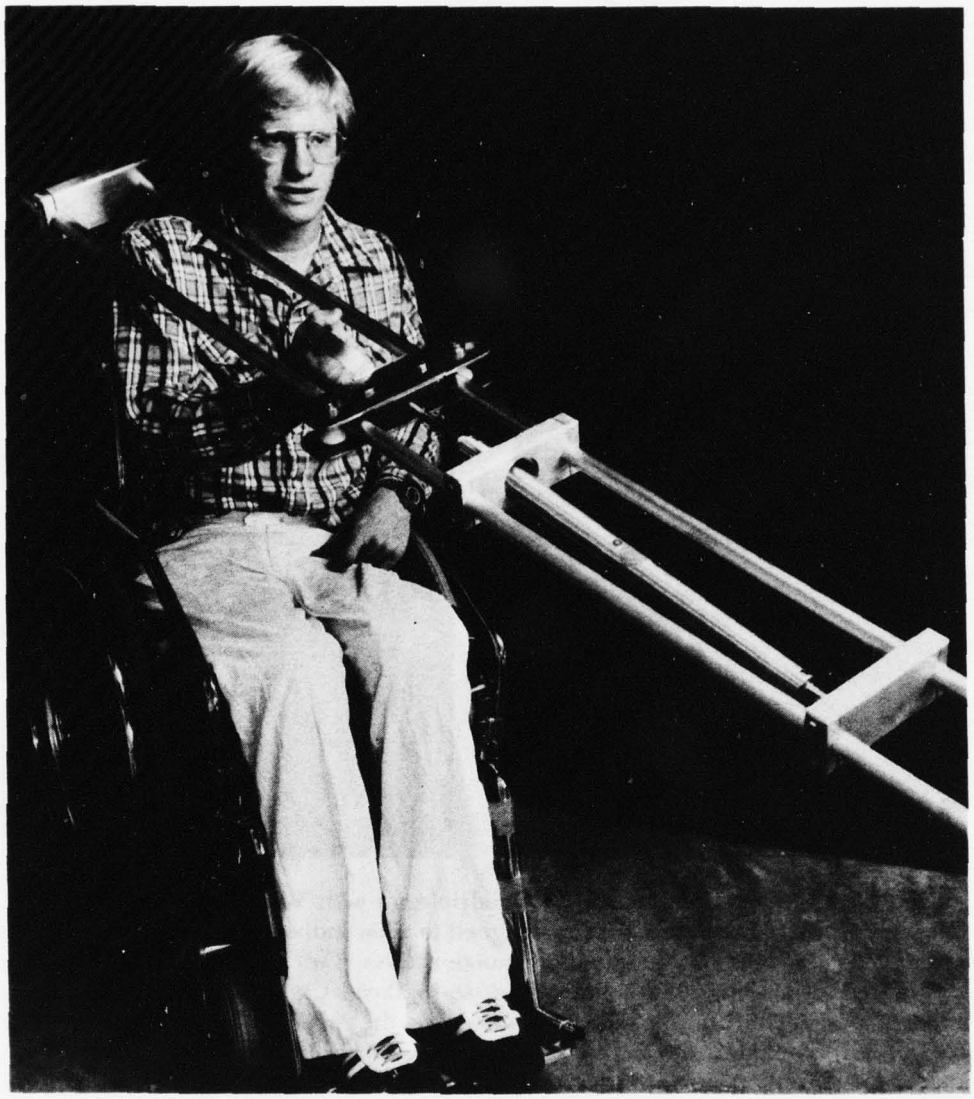


FIGURE 9.—A Servocontrolled Exerciser for Spastic Upper Limbs. This device was designed to provide a tireless exerciser which would be responsive to the patient's capability. It can be programed such that loads experienced by the user are always at the threshold where maximal learning and conditioning are accomplished. The range of motion can be set to prevent muscle or tendon damage. The design team included Peter Axelson (BSME candidate), Ken Allen (MSME candidate), and Tom Woo (MSME candidate). Peter Axelson demonstrates use of the exerciser.

floor and shelves. It was observed that only wrist extension was present for most of these people and that all existing reach-assist devices required grasp. The design objective held that a simple, user-actuated device should be wheelchair-mounted and should allow one to pick up coins, cigarettes, and objects as massive as a full soft drink can. Two devices were built. One achieved the design objective using do-it-yourself technology. The second device achieved the same objec-

tives with additional features and required commercial fabrication technology. The best device is now seen to be a combination of design features found in both of the student prototypes. A second generation reacher is now being produced preparatory to seeking commercialization of the device.

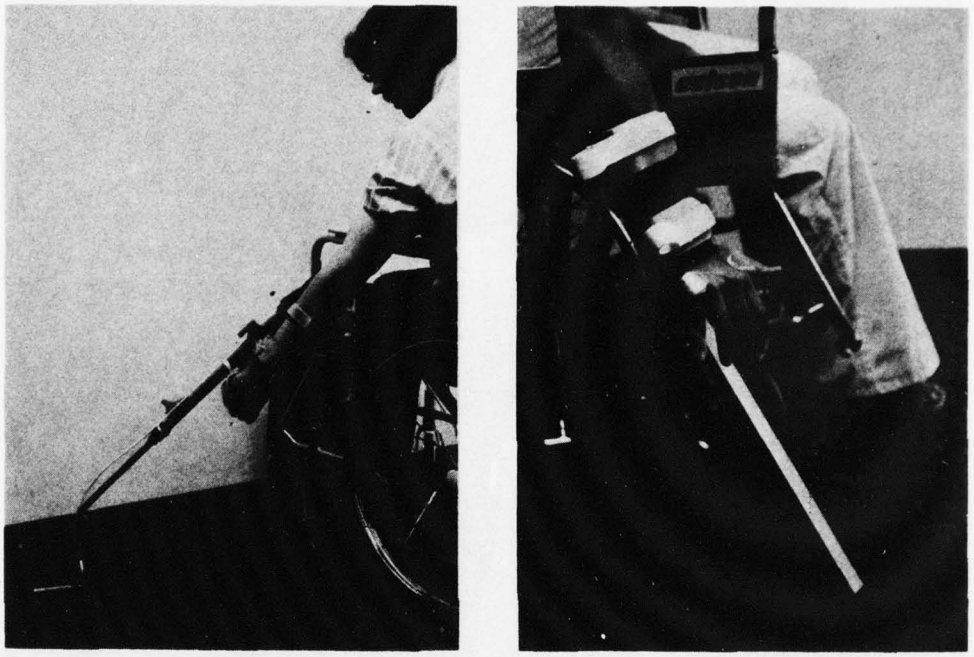


FIGURE 10.—A Reacher for C5-C6 Quadriplegics with Wrist-Extension Capability. This body-powered reacher has been designed to allow individuals with wrist extension to grasp objects from the floor and/or remote shelves. Two versions of the device are shown here. The design on the left was done by David Uken, Bachelor of Science in Product Design (BSPD) candidate. The design on the right was done by Joni Bessler, also a BSPD candidate, who identified the need for such a device. Both mechanisms are capable of picking up coins and beverage cans. The reacher is transported in an easy-access bracket behind the wheelchair.

Summary

The Veterans Administration has established a Rehabilitative Engineering Research and Development Center (RER&D Center) at its Palo Alto Medical Center. The RER&D Center will operate in close affiliation with the Stanford University School of Engineering and School of Medicine. The center has a broad mandate. It is a new venture and one encouraged to test new approaches to the problem of bringing technology to the aid of physically disabled persons.

Editor's note: Our first report from the VA's new RER&D Center at its Hines, Illinois, Medical Center is scheduled for the next issue of BPR. However, a progress report on work recently transferred to the center starts on page 72 of this issue.

Prosthetics Research

Northwestern University, Prosthetics Research Laboratory
Room 1441, 345 East Superior Street, Chicago, Illinois 60611
Robert G. Thompson, M.D., and Dudley S. Childress, Ph. D.

Powered Arm For Shoulder Disarticulation Levels

A Ph. D. candidate has begun studies related to the control of a multifunctional prothesis. During the course of this study, the following experiments are to be performed:

1. Analyze the ability of normal persons to control elbow flexion/extension and wrist pronation/supination.
2. Analyze the ability to control shoulder elevation/depression and abduction/adduction.
3. Analyze the ability to relate the above movements to elbow and wrist motion in a prosthesis.
4. Compare extended physiological proprioception (EPP) position-servo control to simple on/off and velocity control.

An orthosis with electrogoniometers at the wrist and elbow has been constructed to being the study as stated in item 1.

Lightweight BK Prosthesis

One amputee has been fitted with a low density polyethylene/foam below-knee prosthesis. The polyethylene socket did not have the rigidity to withstand the loads exerted during the stance phase of ambulation; therefore, its use was discontinued.

A second polyethylene/foam prosthesis has been fabricated similar to the first except that polypropylene has been used for the socket. No clinical results are available as yet.

The Otto Bock SACH foot 1S19 is now used for the flexible forefoot with the lightweight prosthesis. Because the keel is already reduced in size, the prosthesis fabrication time is diminished.

Preparatory Lower-Limb Prosthesis

Intermediate BK prostheses have been fitted to two more subjects bringing the total fitted to six. Early failure of the Aquaplast® material, due to age-hardening and subsequent cracking, appears to have been overcome by the manufacturer. The Aquaplast® sockets now last the full term of the intermediate prosthesis without cracking. Work continues on reducing fabrication time and improving suspension of the prosthesis.

Synergetic Hook

The first prototype of Model II has been completed, incorporating all of the changes mentioned in previous reports. To diminish battery drain, the drive current to the "fast" finger will be cut off by a motor-

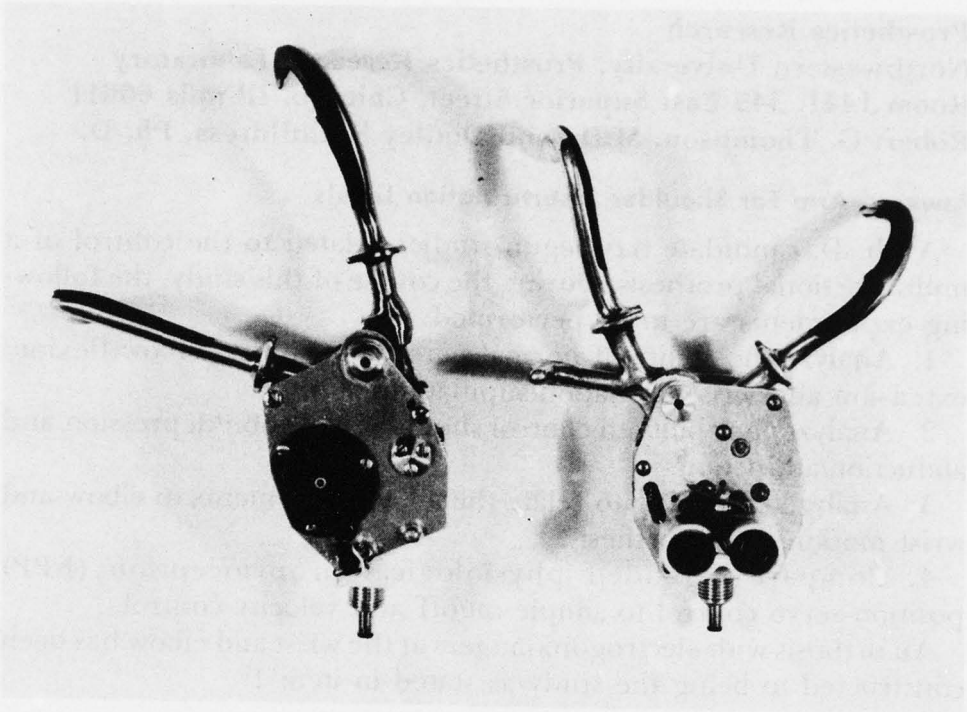


FIGURE 11.—Northwestern University Synergetic Hook Model II, at left and Model I, at right.

rotation detector. Two more units, one left and one right, are being constructed for clinical evaluation. The changes made between Model I and Model II are shown in Figure 11.

Design work has begun on Model III, which will be identical to Model II except that the fingertips will be removable. This will give the user several possible options, such as which tip type to select for working with different materials and shapes.

Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Protheses

University of California, Los Angeles
School of Engineering and Applied Science
Biomechanology Laboratory, 3116 Engineering 1
Los Angeles, California 90024
John M. Lyman, Ph. D., and Amos Freedy, Ph. D.

Microprocessor-Based Upper-Limb Project

Progress on this project includes the development of a new harnessing technique to allow reliable placement of nine EMG electrodes on the residual limb and shoulder girdle of an above-elbow amputee.

A lightweight, two-way-stretchable material was used to fabricate a "T-shirt" on which the EMG electrodes could be attached. The material provides elastic pressure on the electrodes, and allows continuous contact with the skin during arm movement, as well as during muscle contraction.

The first harness prototype demonstrated its potential, and a second model has been designed and is currently being tested. It is intended to achieve the following advantages:

1. Less donning and doffing, allowing the amputee to harness himself without help;
2. Easy removal of the electrodes so that the "T-shirt" may be washed regularly;
3. Material with the same elastic properties as the earlier model but with a coarser weave, to allow proper ventilation to the torso; and
4. EMG electrode wires packaged in a reliable and cosmetic manner.

In parallel with this work, a new technique has been developed to increase the information content extracted from the myoelectric signal, and thereby to improve the reliability of the movement decisions of the pattern-recognition algorithms. The technique, Auto Regressive Integrated Moving Average (ARIMA), enables provision of reliable myoelectrically-based information, independently of certain subject variations and muscle fatigue states. Interaction of the above parameters has been defined, as has crosstalk of the adjacent muscles, making possible optimal electrode placement.

The ARIMA technique is currently implemented and is being tested on our laboratory system. Long-term objectives are to include it in the clinical system.

Functional Neuromuscular Stimulation of Limbs

Work to date has shown that fine proportional control of paralyzed muscles can be accomplished by the employment of the Selective Electro Block (SEB). The SEB pulse amplitude, width, and frequency were shown to be possible control parameters of muscle force level. Pulse widths in the range of 10–700 microseconds and pulse amplitudes of several milliamperes (depending on electrode-nerve resistance) are appropriate. Pulse rate of 100 to 600 pulses per second also showed linear relationships to muscle force. Dynamic control was feasible by SEB pulse amplitude and width; however, dynamic control using SEB frequency showed erratic and unreliable response, and should be investigated further.

Control of an Artificial Upper Limb in Several Degrees of Freedom

Department of Electrical Engineering
Illinois Institute of Technology, Chicago, Illinois 60616
Daniel Graupe, Ph. D.

Orthopedic Surgery Department
Loyola University, Chicago, Illinois
John Fisk, M.D.

Both investigators are also attached to the VA Rehabilitative Engineering Research and Development Center, Hines, Illinois

Multifunctional Myoelectric Actuation of Above-Elbow Prostheses via Time Series Analysis and Classification Methods using Microprocessor Hardware

This report covers the period of July 1, 1978 to December 31, 1978 and extends previous work by the first author performed while on the faculty of Colorado State University, prior to his move to Illinois Institute of Technology and his joining, with the second author, the VA Rehabilitative Engineering Research and Development Center, Hines, Illinois.

The main aspects of the work over the first 6 month period of this project at its new location were as follows:

1. Interfacing the microprocessor actuation system with a modified VAPC arm, containing elbow, wrist and prehension motors.
2. Enhancing system reliability to beyond the success rate of 90 percent that had been achieved previously (1).

Specifically, the work on interfacing the system with a VAPC elbow-wrist-hand mechanism has now been completed via a newly acquired multi-channel digital-to-analog converter (DAC) system. Tests on the combined system have been performed at Illinois Institute of Technology, and once a laboratory has been allocated for this project at the VA Hospital at Hines, these tests are to continue there. Presently, the system is fully functional in that it enters the myoelectric signal from a single surface electrode pair (Motion Control, Inc., Salt Lake City, Utah) placed on the residual limb of the amputee. The signal then goes through an analog-to-digital converter (ADC) system to an INTEL 8080-based microcomputer system where its autoregressive (AR) parameters are identified on-line. These AR parameters are then compared with reference AR parameters in the computer's memory as obtained at a previous calibration mode for the amputee and for the same electrode location. A classification algorithm then decides if the presently identified AR parameters set belongs to any of the reference AR parameter sets, and if so to which, noting that each reference set uniquely belongs to a certain limb function.

Finally, the limb function thus classified is actuated once detected as above in the sense that the recognition decision by the microcomputer causes a signal to be sent through the DAC system to the appropriate motor of the VAPC arm to actuate one of the (presently 5) limb functions, namely: elbow flexion, elbow extension, wrist pronation, wrist supination and hold. Extension to 7 limb functions is mainly limited by lack of hardware. The major other remaining problem here is that we are still unable to use any newer microprocessor but are limited to the INTEL 8080 8-bit microprocessor purchased in 1975. Presently microprocessors which are faster by almost 2 orders of magnitude are available, which can be in 16-bit form to greatly enchance speed and accuracy. However, even present speeds fully justify clinical use of the system. Present actuation delays for the most reliable (99 percent success rate version) are of the order of 1 sec, which by a mere component change can be brought down to below 0.1 sec. Less reliable versions operate at 0.2 sec. delay but are not recommended due to their higher error rate.

Concerning success rate enhancement (i.e., enhancement of rate of correct actuation) this was brought up from some 90 percent to 99 percent by a complete revision of the training routine of the user and by rewriting the classification algorithm. This algorithm is now a recursive elimination algorithm with modified weights which allows very fast classification — 5 times faster than the one reported in (1).

To preserve 99 percent reliability while increasing the number of limb functions from 5 to the desired 7, a system with two surface electrode pairs is being investigated. In this system the classification base will be increased, with 3 parameter sets per function compared with corresponding sets obtained during calibration. The three sets are the AR parameters of the signals from each of the two electrode pairs, plus a cross parameter based on the cross covariance between those two signals (2).

It is believed that with the present success rate and with the completion of the arm-to-microcomputer-interface, the system is now ready for extensive and thorough clinical evaluation and then for use by amputees in situations where multifunctional reliable actuation at will is important, such as in cases of high bilateral AE amputees. Tests on cases of shoulder disarticulation will also be considered as will be the evaluation for diagnostic and other purposes, since once the information in the EMG signal can be reliably interpreted, above-elbow prostheses are not the only application for this method.

References

1. Graupe, D. et al.: A Microcomputer System for Multifunctional Control of Upper-Limb Prostheses via Myoelectric Signal Identification, IEEE Transactions on Automatic Control, AC-23, (4) 538-544, 1978.

2. Graupe, D.: Identification of Systems, 2nd edition, R.J. Krieger Publishing Co., Huntington, N.Y. 1976.

Spinal Cord Diagnostics based on Stochastic Signal Processing via Microprocessor Hardware to Enhance Evoked Potential Monitoring Speed and Reliability

This report covers work started in October 1978. It thus covers barely a 3 month period and we cannot report clinical findings as yet. Initial clinical test results are, however, expected to be available in the summer of 1979.

The main effort during the past 3 months was concerned with the design of interrogation signals for evoked potential spinal cord monitoring, noting that presently evoked potential interrogation signals are generated in what is mathematically an ad-hoc manner. This ad-hoc approach of selecting signal amplitudes and shapes implies that for any diagnostic conclusions one presently requires many hundreds or thousands of signals at intervals of the order of one second. Hence response information takes something of the order of an hour. Furthermore, this ad-hoc nature of the presently employed signals implies that evaluation of responses is very unreliable due to its implicit sensitivity to noise and other disturbing electric activities of the body, including seizures etc. Our approach is to overcome these problems by an optimal or a near-optimal design of the interrogation signal and of its processing such that the evaluation can be *firstly* very rapid (to be complete in the order of a few minutes) and *secondly* that response information will be insensitive to noise and other disturbances in a near-optimal fashion. For this purpose we employ signal design methods based on stochastic identification theory such as in (1) and (2) (for input design, i.e., design of interrogation signal shape and spectrum, and for stochastic response analysis). These have near-optimal filters built into them rather than relying on averaging techniques that made sense as long as processing was mainly analog or has employed only computationally weak digital circuits. We comment that our present approach is all to be implemented on a microprocessor system, whose software design and electrode interface have already been started.

References

1. D. Graupe: Identification of Systems: 2nd edition, R.J. Krieger Publishing Co., Huntington N.Y. 1976.
2. D. Graupe: Time Series Analysis Applied to Adaptive Filtering, R.J. Kriger Publishing Co., Huntington, N.Y 1979.

Position Control of Above-Elbow Prostheses
Department of Engineering Design and Economic Evaluation

Engineering Center OT 6-34
University of Colorado
Boulder, Colorado 80309
Lawrence E. Carlson, Ph.D.

The overall goal of this project is the design and evaluation of a method for implementing Extended Physiological Proprioception (EPP) for proportional position control of the VA electric elbow, which is normally controlled in an on/off velocity control mode. EPP utilizes small (2 cm) relative body displacements, generated with a control harness, to control the elbow so that there is a linear correlation between input excursion and output elbow position. A mechanical feedback in the form of a very small, flexible cable creates an "unbeatable servo;" i.e., the input is constrained by the output and can only be generated as fast as the output motion allows. This capitalizes on the amputee's proprioceptive feedback and provides a feel for the motion of the prosthesis.

The components required to implement EPP include a small transducer (comparable in volume to the conventional VAPC switch), feedback cable and housing, a small circuit board, and the usual battery. The transducer is mounted in the control harness, while the battery and circuit board fit in the space above the elbow.

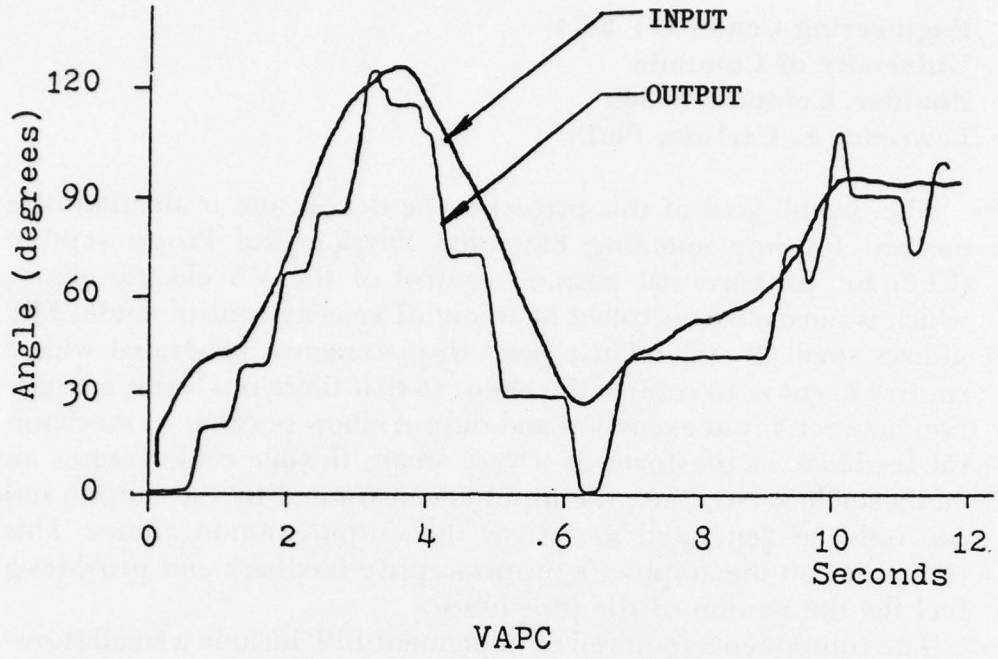
During the period of this report, the system was evaluated in the laboratory by a 25-yr old male amputee with a high-level above-elbow amputation leaving an 8-cm residual limb. Two tests were devised to compare the EPP and velocity control methods: a tracking test and a blind positioning test.

The tracking test consisted of displaying a pseudo-random command signal on a two-channel recorder and requiring the amputee to follow it by moving the elbow to drive the second pen (Fig. 12). A digital computer generated the signal and recorded the average error.

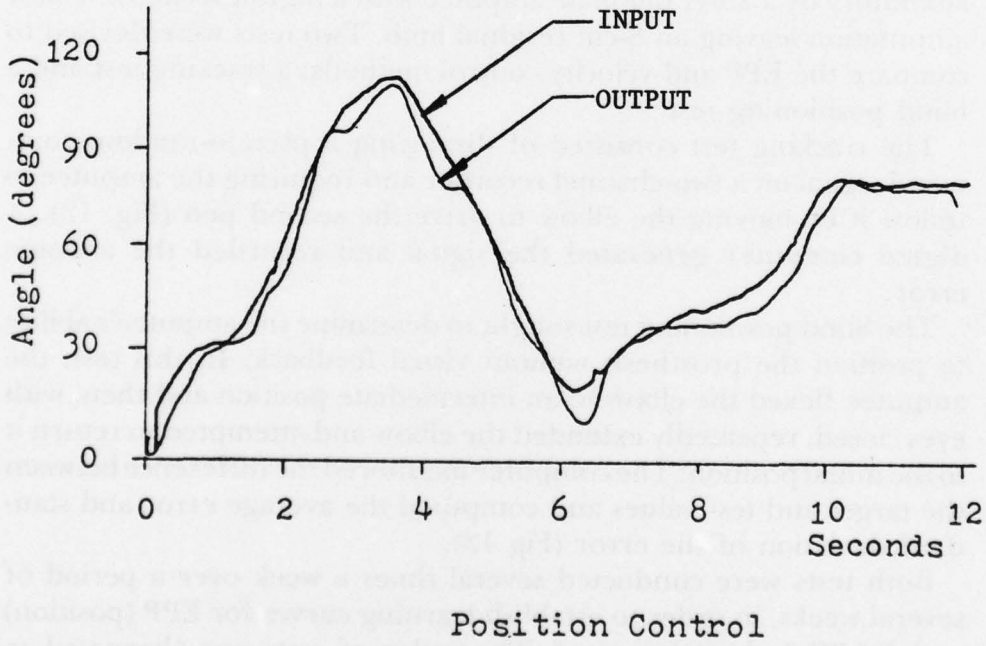
The blind positioning test sought to determine the amputee's ability to position the prosthesis without visual feedback. In this test, the amputee flexed the elbow to an intermediate position and then, with eyes closed, repeatedly extended the elbow and attempted to return it to the initial position. The computer monitored the difference between the target and test values and computed the average error and standard deviation of the error (Fig 13).

Both tests were conducted several times a week over a period of several weeks, in order to establish learning curves for EPP (position) and VAPC (velocity) control. The order of tests was alternated to eliminate bias due to practice time.

In both tests, the position-control method performed consistently better than velocity control (Figs. 14 and 15). In the tracking test, part



VAPC



Position Control

FIGURE 12.—Typical tracking test; 11 results.

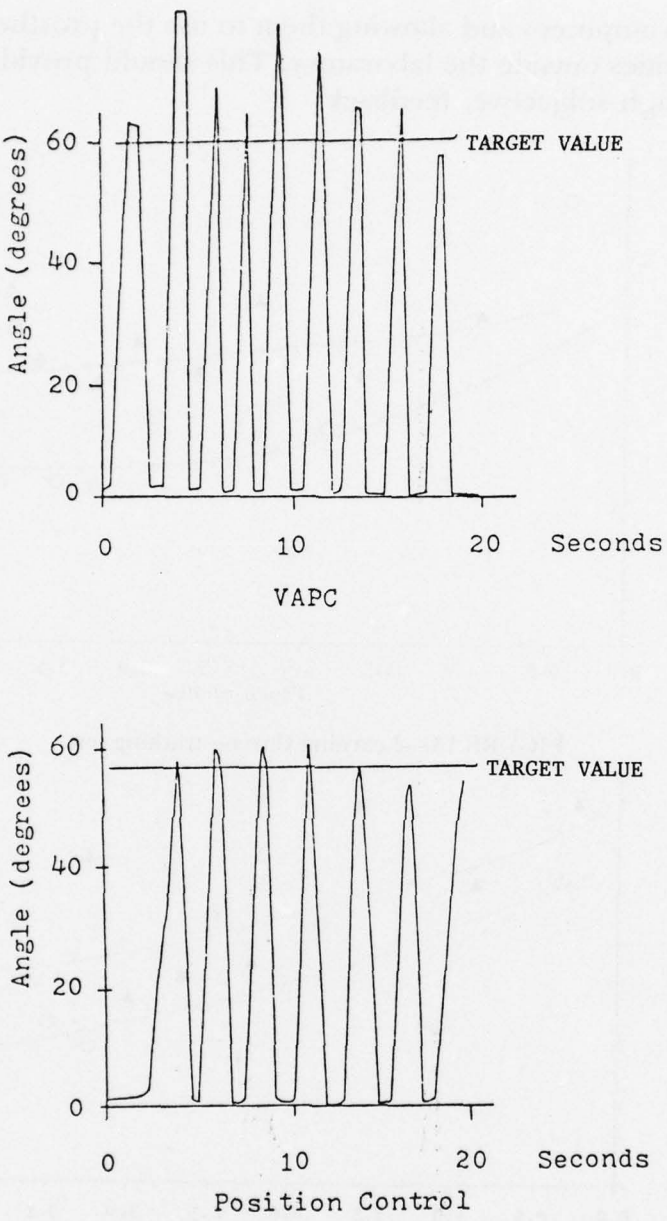


FIGURE 13.—Blind positioning test.

of the result may be attributed to the difference between proportional and on/off control. Later tests with a proportional velocity system showed much closer results, although the position control still outperformed velocity control. In the blind positioning test, position control was better than either on/off or proportional velocity control by almost a 2:1 margin. This is attributed to the ability of EPP to provide non-visual cues of prosthesis position.

Laboratory tests such as these are useful, but they provide only limited information. Therefore, future tests will involve fitting EPP

systems to amputees and allowing them to use the prostheses in their daily activities outside the laboratory. This should provide meaningful, although subjective, feedback.

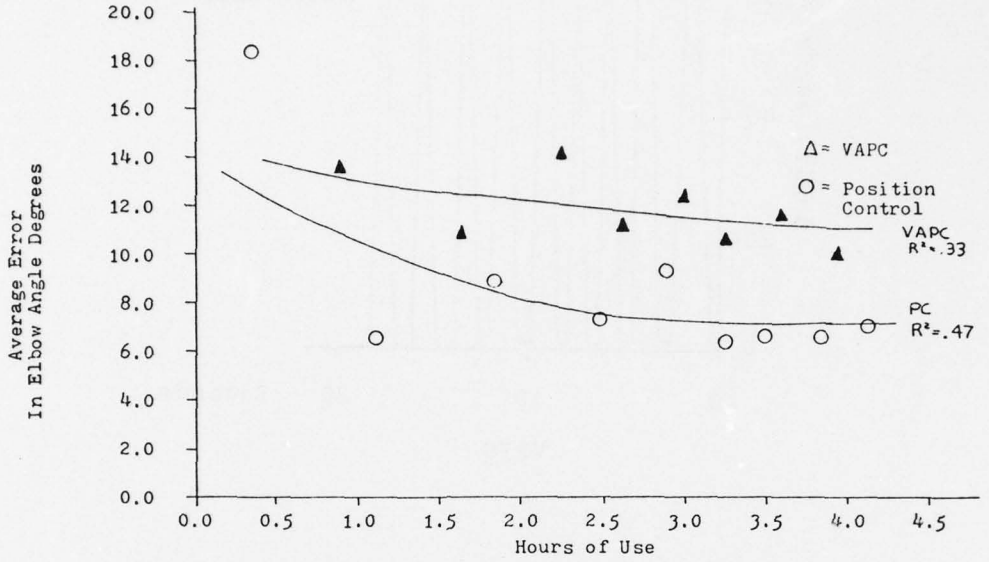


FIGURE 14.—Learning Curve—tracking test.

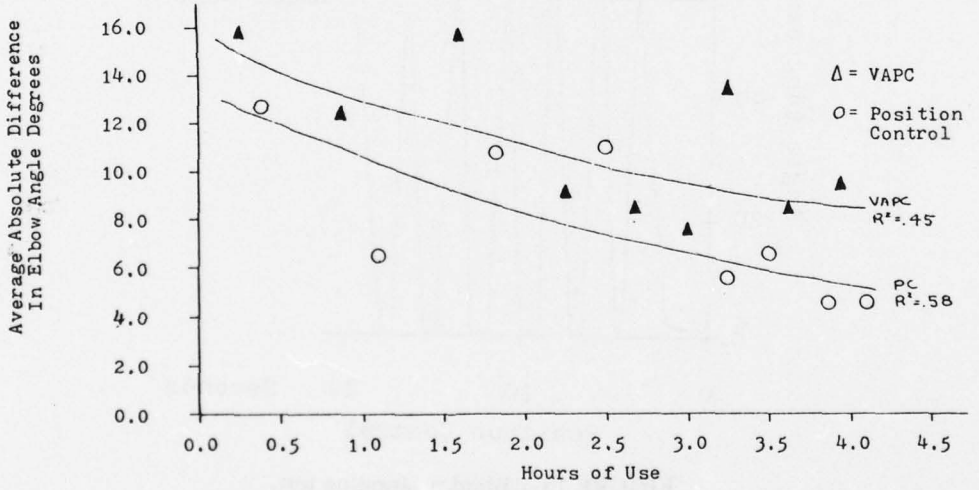


FIGURE 15.—Learning Curve—blind positioning test.

Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prostheses and Orthoses
Applied Physics Laboratory
The Johns Hopkins University
Johns Hopkins Road
Laurel, Maryland 20810
Woodrow Seamone and Gerhard Schmeisser, Jr., M.D.

During the reporting period, July–December 1978, the research program at Johns Hopkins under Veterans Administration sponsorship was concentrated on the continued development of an integrated wheelchair/robotic-arm/worktable system for the high spinal-cord-injured person. Clinical tests with quadriplegic volunteers were continued on the basic elements of the system. The powered wheelchair for this system employs a low-profile chin controller and retractable mouthstick arrangement. Two wheelchairs equipped with this model of the chin controller have undergone clinical testing by three quadriplegics. The interface which permits this wheelchair also to control the robotic-arm/worktable system was tested in the laboratory to demonstrate basic operability, but has not been clinically evaluated. An advanced model of the microprocessor controlled robotic-arm/worktable system is in final software checkout and testing, and is expected to be in clinical tests early in the 1979 calendar year. Progress during the reporting period includes engineering refinements to many elements of the system, and continued clinical testing.

Chin Controlled Wheelchair with Dual Mode Capability

This chin controller is a low-profile design aimed at reducing the mechanism in front of the user's face, and allowing full compatibility with the use of the mouthstick. This controller is shown in Figure 16 in its normal wheechair controller position. The control principle embodied in this controller is to use vertical displacement of the chin for proportional control of wheelchair torque, and lateral chin motion to control steering. A microswitch located on the chin lever allows the user to select reverse mode when the chin lever is in its non-depressed position. When the chin lever is not used for control, it may be pushed aside by the user (Fig. 17). This gives the user a full range of head motion, to allow use of the mouthstick to perform certain tasks.

Three important engineering design changes were made to the chin controller during this reporting period. One change, which is aimed at cost reduction in manufacture, is the use of optical sensors to sense the two axes of motion. This transducer arrangement using low-cost optical sensors is shown in Figure 18. The requirement for a precision potentiometer/gimbal system is eliminated by this design change.

A second engineering change relates to electronic circuitry changes in the interface electronics. A 1 Hz filter was added to the motor torque control channel to minimize the unwanted high-frequency velocity perturbations caused by bobbing head motions on irregular grades. A second electronic filter is activated when maximum steering signals are initially commanded. This second filter is controlled by a one-shot multivibrator and provides filtering during the start-up



FIGURE 16.—Electric wheelchair with low-profile chin controller and retractable mouthstick holder.

transient but does not affect normal steering. This will minimize acceleration response during initial hard turn commands.

A third change made to the chin-controller electronics provides a gain change as a function of selection (chin motion up) of low or high torque for the E & J powered wheelchair.

The net result of these engineering changes provides a chin control system which gives smooth wheelchair motions and is easily controllable. Five additional wheelchairs will be modified and evaluated during the calendar year 1979. Two wheelchairs with the low-profile chin controller (potentiometer version) have been in clinical testing by quadriplegics for over 6 months with excellent results. These clinical results are briefly summarized.

Clinical Experience

All of the evaluators are approximately C-4 level quadriplegics as a



FIGURE 17.—Chin controller in park position. Mouthstick holder in normal use position.

result of spinal cord trauma. All are unable to operate a manual joystick controller. Two have been described in earlier BPR reports, and their evaluation of the early model of chin-controller mounted on a powered Invacare model wheelchair during the previous 6 months was described in the last report—and resulted in the changes mentioned.

One of these individuals was familiarized with the powered Everest and Jennings wheelchair under direct observation of the development and evaluation team, travelling outdoors about the grounds of his nursing home, on grass, paved and unpaved surfaces, and up and down standard wheelchair ramps, as well as indoors about the corridors and rooms. This wheelchair was then left with this individual for his daily use and personal appraisal. After 10 days, his performance was recorded on videotape, segments of which were presented at the Interagency Conference on Rehabilitation Engineering at the

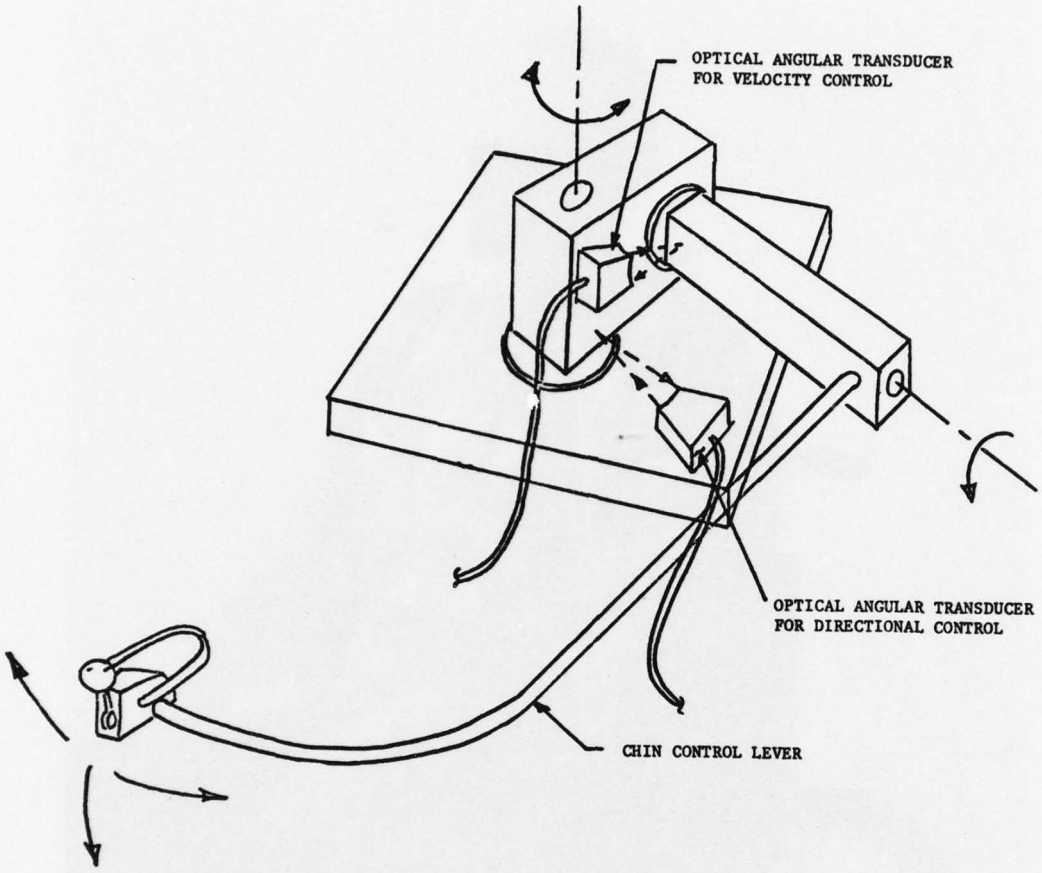


FIGURE 18.—Optical transducer arrangement for chin controller.

Sheraton Park Hotel in Washington, D.C., September 4–7, 1978. This quadriplegic continued to use this wheelchair daily until it was retrieved for assignment to a second quadriplegic approximately 2 weeks later.

Familiarization of the second quadriplegic with this wheelchair took place both within and about the grounds of the laboratory and also included negotiation of inclined surfaces, roadways, sidewalks, negotiation of doorways and corridors, etc. Subsequently, this individual was assigned to this wheelchair for regular use about his home and about the office and loading areas of his moving and storage company. Approximately ten days later, his performance with the wheelchair was evaluated at his place of business by the development evaluation team. A problem of moving his chin control lever far enough from his face in its rest position to permit use of a telephone operator's earphone/microphone combination was noted and solved by adjusting the park position of the controller and adding an extension to enable retrieval by neck extension. This wheelchair was re-

trieved for demonstration at the Interagency Conference and then was returned to the same individual for more prolonged evaluation. With further use, the aforementioned need for improved turn control was noted and the system was recalled for corrective modification as described earlier in this report.

The third evaluator is a 17-year-old C-4 quadriplegic. He sustained his injury during the early part of the report period. Cervical spine fusion was performed and protected with a halo and subsequently a cervical collar. He was familiarized with the powered Everest and Jennings wheelchair and low-profile chin controller under observation of the development and evaluation team approximately four months post-injury, while still in the hospital and while still regaining cervical spine motion. At the time of familiarization, he had not regained more than about 50 percent of normal cervical spine motion, but was able to operate the chin controller, wheelchair and retractable mouthstick mechanism to the extent of design limits.

All three evaluators remain enthusiastic about the equipment and anxious to have the electric wheelchair with low-profile chin controller for regular use.

Retractable Mouthstick Holder

A new aspect of this chin-controlled wheelchair is the addition of a motorized mouthstick holder (Fig. 6). It is well known that one of the more useful tools for many high-level quadriplegics is a mouthstick. It provides him a means of manipulating pages of a book, electrical switches, TV pushbutton controls, telephones and other similar devices. In order to make the mouthstick available to the quadriplegic at his command, yet out of the way when not being used, the system under development at Johns Hopkins employs a mechanized mouthstick holder mounted on one arm of the wheelchair. This system is motorized and is activated by the chin controller at one of its extreme lateral positions. The mouthstick is shown in Figure 16 in its storage position—approximately parallel to the user's arm and within the envelope of the wheels of the wheelchair. Upon command by moving the chin controller to the extreme left and slightly downward, the mouthstick is automatically moved into its use position (Fig. 17). As with the previous two-piece mouthstick design utilized in the robotic-arm/worktable system, the longer mouthstick may be utilized for tasks such as turning pages of a book, whereas the shorter length may be used for typing or touch-tone dialing the telephone.

The chin controller and mouthstick holder are designed as a mutually compatible system. Clinical tests are planned to further evaluate this concept. This wheelchair controller design is also compatible for control of the JHU robotic arm by suitably driving the wheelchair into proximity of the robotic-arm/worktable, and utilizing an infrared

beam to transmit control signals from the chin controller to the robotic arm input sensor. This feature had previously been described in BPR 10-30, Fall 1978, issue of the Bulletin of Prosthetics Research. This coupling feature will be incorporated on all the latest robotic arm models under development at Johns Hopkins.

Robotic Arm/Worktable System

In September 1977, the first APL/JHU microprocessor-controlled robotic-arm/worktable system was furnished to a quadriplegic for testing. Over 15 months of clinical test time has now been accumulated and results from these tests demonstrated the practicality of this approach. Appropriate engineering refinements obtained from these clinical tests have been incorporated into a later model now undergoing final software and hardware validation. This improved model features a display panel which is easier to use and includes a keyboard to allow the user or an attendant to easily preprogram or change the program for selected tasks. Packaging has been improved by the use of a ribbon multiwire flat cable which has eliminated the external wire harness from the robotic arm to its power supply. This model represents a prototype of an advanced microprocessor controlled robotic arm. A third unit currently being tested at UCLA will be modified to incorporate the features of this model to expand the clinical data base for the APL/JHU robotic-arm/worktable system.

Future Plans

Clinical testing of assistive devices for the high spinal-cord-injured will be continued in two directions. One approach will utilize the powered wheelchair with the low-profile chin controller and compatible pop-up mouthstick arrangement, in combination with various simple non-mechanized worktable arrangements. This should provide capability for reading, typing, playing some games, and should allow operation of unmodified electrical switches and similar devices capable of being operated by a mouthstick. The second approach will use the same wheelchair configuration but with the robotic-arm/worktable arrangement. Planned clinical evaluation of three systems for each approach will help assess the relative merits of each system in a practical clinical environment, and will help determine the factors involved in selecting and prescribing one system over the other.

Research and Development in the Field of Artificial Limbs
Mauch Laboratories
3035 Dryden Road
Dayton, Ohio 45439
Hans A. Mauch

Hydraulic Ankle Control System

The ongoing shakedown tests continue to prove very valuable in bringing out persistent shortcomings of the present ankle design, such as noises, parts working loose, leaks, and structural weaknesses. The most serious finding was that the athletic test amputee (G.S.) in New York, who has already broken two piston rods (his original one in normal use and a stronger heat treated one during skiing), has now twisted a third structurally reinforced one 20 deg out of shape in playing baseball (swinging at bat).

Although the piston rod no longer breaks off but is only deformed, it is obvious that a more drastic structural redesign will be necessary to make the Hydraulic Ankle strong enough for athletic amputees like this one. This will take time. However, the effort seems worthwhile, because once this difficult problem is solved, all other amputees will benefit from the longer life and the increased safety of the resulting device. The wear periods prior to the fractures were: Unit No. 5, one-half yr everyday use including athletics; Unit No. 4, 1½ yr everyday use, and for Unit No. 6, a few days of use—terminated by skiing. Two other (quite active) amputees in Dayton and Arizona have been using their units (No. 1 and No. 2) for over 3 yr each without fractures, and another unit (No. 3) used by several amputees in Dayton and New York has been in use for 1½ yr without fracture.

To understand the problem, one has to remember that the design space for the Hydraulic Ankle is very limited, and that its weight must be as low as possible because it is located at the most distal point of the limb, packing quite a momentum as a result. In addition, the forces acting on the Hydraulic Ankle during the various activities are difficult to assess, considering the range of characteristics of the amputee himself, and the cushioning effects of the foot gear, the foam foot, and the rubber elements at the attachment points of the unit within the leg, as well as the variations in the hardness and friction effects of the walking surface, etc. Considering all these factors and the fact that the fractures occurred only sporadically, it appears that the original computations, which had the goal of obtaining the smallest and lightest possible ankle design, came very close to this ideal.

As mentioned above, the strength of the piston rod has been increased by shape changes and by a different heat treatment, to achieve a theoretical strength increase of 25 percent regarding flexural stress. In addition, a series of tests in cooperation with a local Materials Testing Laboratory (Bowser-Morner) was initiated, to determine at what loads the piston rods break. To understand the test results, one has to know that the force acting on the ball of the prosthetic foot in an upward direction (due to the weight of the amputee and any acceleration force he may apply) is converted by the ankle into a bending moment within the piston rod which is being

counterbalanced by a force acting onto its upper end in a forward direction. Since the lever arms from the ball of the foot to the ankle bolt, and from the ankle bolt to the upper end of the piston rod, are roughly the same, the forward force acting on the upper end of the piston rod approximately equals the upward force acting on the ball of the foot.

The forward loads which had to be applied to the piston rod to produce a fracture were found by the testing laboratory to be 627 lb for the old piston rod which the amputee broke, and 780 lb for the reinforced piston rod. The strength increase was approximately 25 percent as expected. The puzzling fact is that even the lower load of 627 lb is 3½ times the weight of the amputee (180 lb) and that it is highly unlikely that he can produce a load of 3½ times his weight by acceleration (G-) forces.

Since one amputee broke one of his units during skiing, it was established by New York that he used a modern rented ski of the type which can be adjusted to release the ski boot when certain forces lifting the heel upwards and certain twisting forces around the vertical axis are exceeded. It was also established that these adjustments were carried out, when he rented the skis, in accordance with his body weight and level of expertise. From tables studied in a Dayton ski shop it was found that the upward acting heel force adjustment he was most likely given was about equal to his body weight. This means that the maximum ball pressure he could have exerted by leaning forward (before the ski boot would come off) would have to be twice his body weight. Since the ski boot did not come off, the ball pressure must not have reached 360 lb—a load far below the 627 lb needed for breaking the piston rod. So, it appears that the rod did not break as a result of bending stress alone.

A similar investigation regarding a possible fracture due to torsional stress was undertaken. It showed that, considering the results from the testing laboratory (breaking torques of approximately 410 and 460 in-lb for the two piston rods) and the probable setting of the ski boot release force for torsion, torsional stress could just barely have been the reason for the fracture in skiing, but could not explain the fractures in every day use because in that case the foot would rotate on the ground long before torques of that magnitude could develop.

Tests involving superimposed flexural and torsional forces were also considered, but were difficult to design realistically because of the necessary assumptions regarding the ratio between these two kinds of forces as they may occur in actual use of the ankle.

Finally, the possibility of fatigue fracture was investigated. In the skiing case, fatigue had to be ruled out because the fracture happened after only 2 days of use of the restored Unit which contained a new piston rod. The other two cases, involving Units No. 5 and 4, did not

look like fatigue fractures. Furthermore, one has to consider the following facts. Although the aluminum casting material used in our piston rods has a nominal fatigue strength of only approximately one-half of its ultimate tensile strength, these values are obtained by fatigue tests in which a sample is subject to a given stress alternately applied in both directions. In the present application, the stress acts predominantly in one direction which results in a fatigue strength much closer to the ultimate tensile strength of the material.

At this writing, all the existing systems have the reinforced piston rods, which will make fractures in everyday life much less likely. As to the use of the reinforced system for skiing, amputee G.S. will test this in February, 1979. Generally, even if all goes well, the strength of the hydraulic unit will still have to be markedly increased to provide a sufficient safety margin for everyday use and particularly for skiing and similar athletic activities.

Another fairly serious finding was that U-seals of polyurethane rubber take a set, causing internal leaks and a creeping dorsiflexion stop even when installed in hydraulic units with minimal clearance between housing and piston. This called for a tentative return to Viton U-seals, which do not take a set but have serious molding problems and other disadvantages. It seems that a new rubber compound will have to be found which will, it is hoped, combine the best qualities of both Viton and polyurethane.

Future Plans

Support for the development phase of this project terminated September 30, 1978. The shakedown testing, however, continues in New York with the goal of achieving an acceptable production item by the end of 1979.

Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion

Biomechanics Laboratory
University of California, Berkeley
5144 Etcheverry Hall
Berkeley, California 94720
Charles W. Radcliffe, Donald M. Cunningham, James M. Morris, M.D., and Larry Lamoreux, Ph. D.

Design of Lower-Limb Prosthetic and Orthotic Devices

Four-Bar-Linkage Polycentric Pneumatic Knee

Fifty units are scheduled for delivery in January 1979. These will be used for evaluation fittings at San Francisco VA Medical Center and other qualified institutions.

Six-Bar-Linkage Knee with Friction Swing-Control

The prototype unit has been worn continuously by a 110 kg (240 lb) amputee since September 1978. The unit has proved to be structurally sound. The polycentric action provides enhanced voluntary control of stability that is somewhat less pronounced than that of the 4-bar knee. The friction swing control has not maintained its settings well and will require further development.

Friction-Stabilized Knee

This previously reported knee (BPR 10-30, page 193) is designed to engage a knee brake at heel contact but to release the brake prior to toe-off in order to allow smooth entry into swing phase (Fig. 19). The same brake also serves as an adjustable friction swing-phase control. Special instrumentation has been developed to obtain measurements of brake friction as a function of applied braking force and knee angular velocity. This information is being used to develop a computer model of the knee. The model will permit optimization of swing control characteristics without the actual construction of a series of prototypes. Tests indicate that braking action increases with increasing angular velocity, an unexpected result that suggests the possibility of an excellent swing control effect.

SACH Foot with Metal Keel

Patterns have been prepared for two prototype cast aluminum keels. The first had a channel-section structure that turned out to be undesirably heavy (140 g). The second made use of an I-beam structure that was significantly lighter (110 g). Feet were molded with both keels, achieving total weights with integral pylon couplings of less than 600 g. Comparative destructive strength tests of the two keel designs are in preparation. Amputee assessment of function of the prototype units continues to be favorable.

Multi-Input Control of Knee Stability

A preliminary laboratory investigation of multi-input control of knee stability has been concluded. The experimental knee prosthesis consists of a single-axis knee mechanism with a U.S. Manufacturing Company Dyna-Plex hydraulic swing-phase control unit. The hydraulic damper was modified to allow servomotor control of the valve position. Figures 20 and 21 show the experimental knee prosthesis.

The servo valve was controlled by the Biomechanics Laboratory NOVA minicomputer, using special programs that responded to data from feedback transducers located on the knee prosthesis. Signal transfers were achieved by means of an electrical cable connecting the prosthesis to the minicomputer, so the present prototype is strictly for laboratory use.

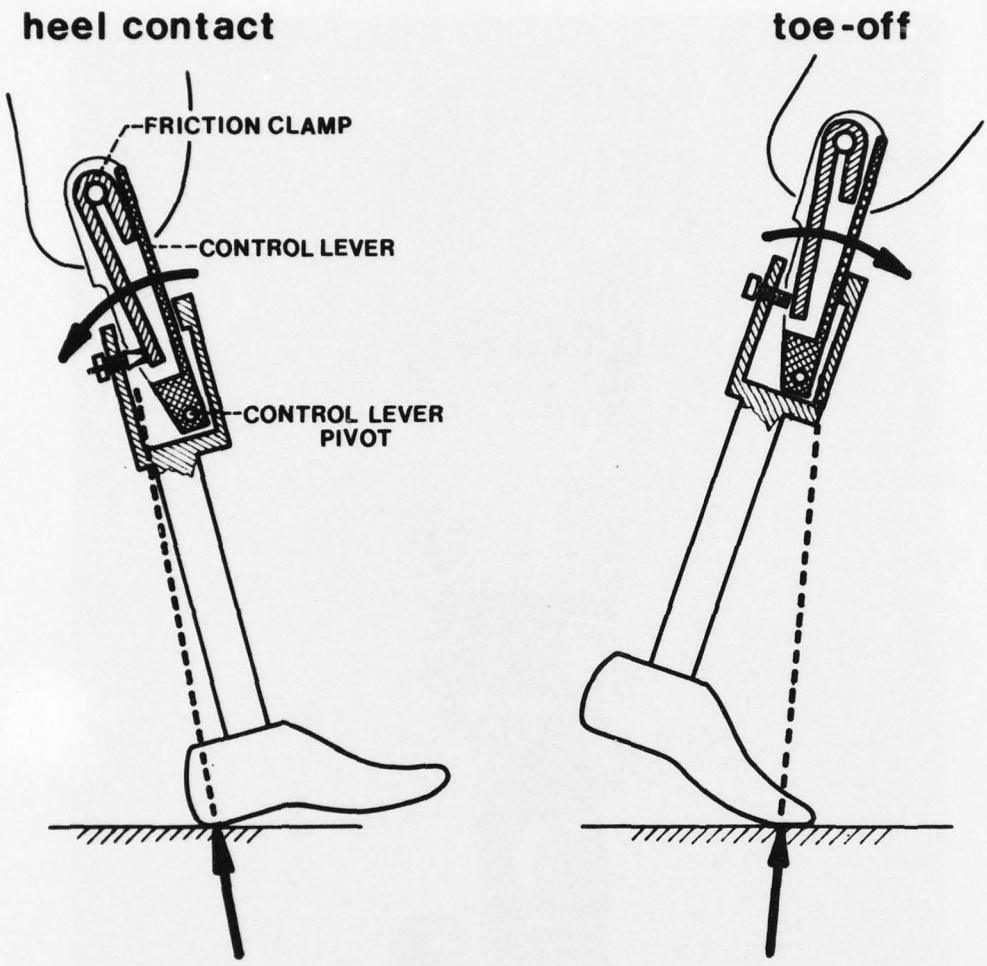


FIGURE 19.—Schematic representation of the UC-BL Friction Stabilized Knee, showing the mechanism by which the knee brake is applied at heel contact and released when load is transferred to the forefoot.

One significant change in the hardware was made since the last report. The knee angular-velocity transducer was eliminated and replaced by an analog differentiator which operates on the knee angular position. A reduction in size and number of components resulted. The slight time delay that resulted from this change (Fig. 22) had no objectionable effect on performance.

In order to test the actual performance of the knee prosthesis control system, a series of experimental runs was conducted. The designer himself was the subject for all the experiments, using a bent-knee socket. A total of nine runs was conducted for the normal walking mode. The experimental conditions were varied to include a slow speed (0.6 m/sec), a medium speed (0.8 m/sec), and a fast speed (1.0 m/sec). Three levels of swing-phase control were used for each walking speed.

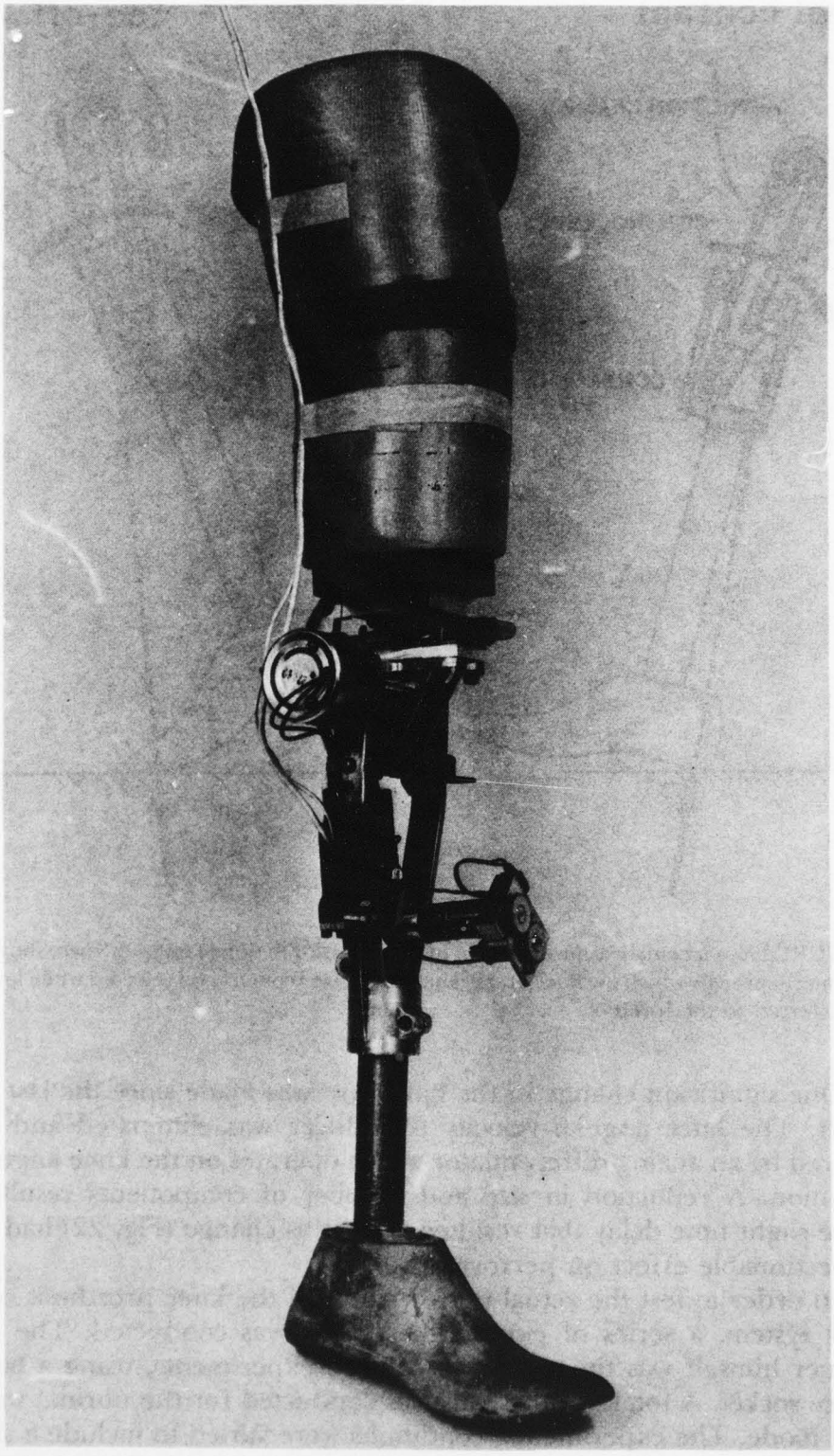


FIGURE 20. — Multi-input computer-controlled experimental knee prosthesis.

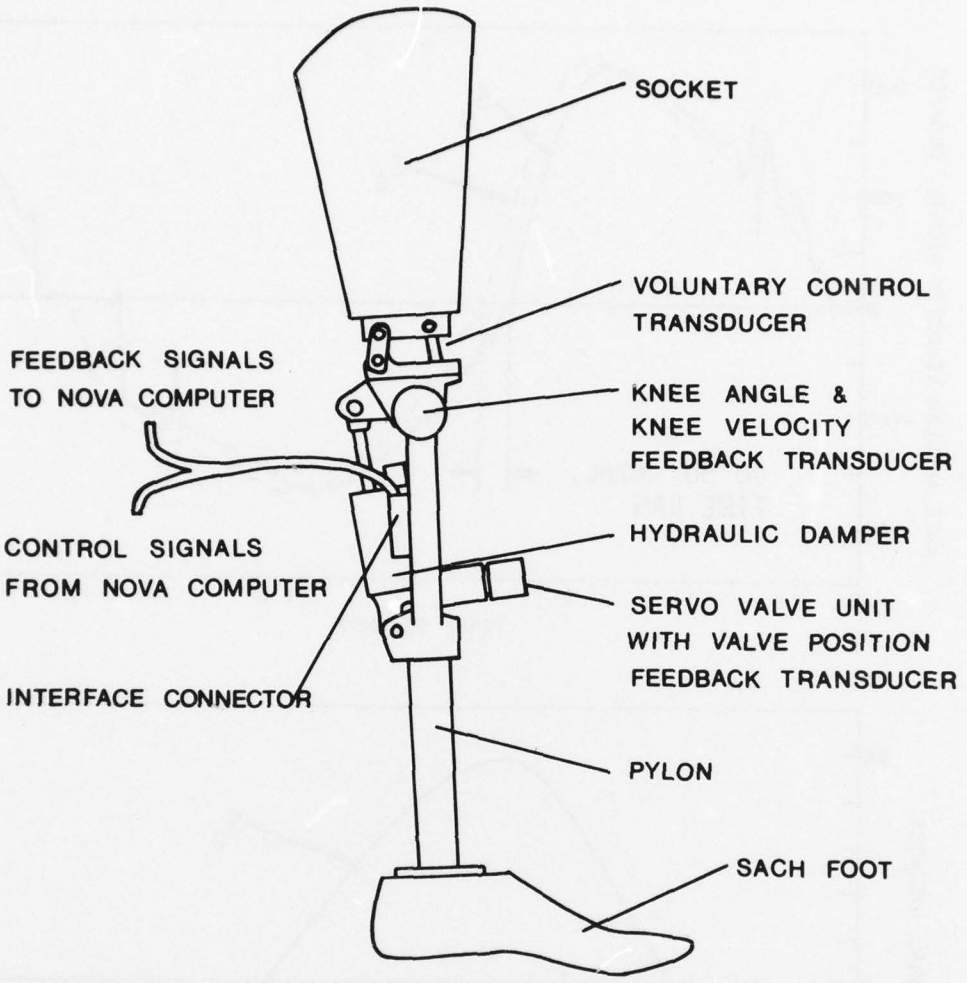


FIGURE 21. — Diagram showing various components of the multi-input computer-controlled experimental knee prosthesis.

The performance of the knee prosthesis control system during normal walking was very satisfactory. Damping during swing phase was effective and predictable (Fig. 23). The change from swing phase to stance phase is detected in the computer by noting the cessation of extension angular velocity. The change from stance phase to swing phase is initiated by a hip flexion moment greater than a preset value. Both of these cycle control methods were very satisfactory.

Several tests were made of the ability of the test subject to initiate controlled flexion during stair descent. Three methods of control were tried and determined to be possible candidates for the final selection. These are:

1. The subject generates a voluntary control signal (hip flexion or extension moment) to open or close the valve. The amount of valve opening is proportional to the magnitude of the voluntary control

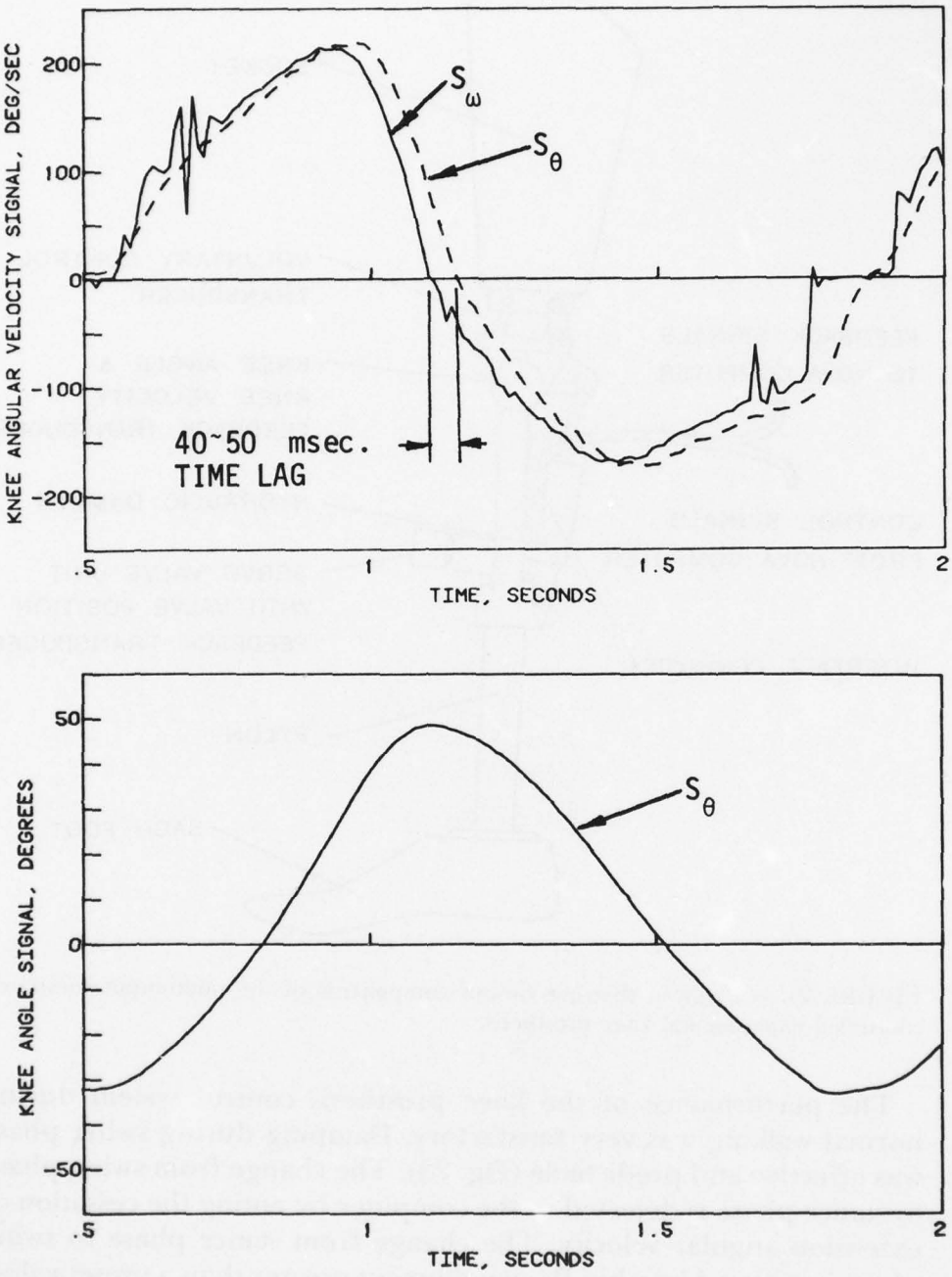


FIGURE 22.—Comparison of signal obtained from the knee angular-velocity transducer (S_ω) versus signal obtained from analog differentiator S_θ. Time lag of 40 to 50 ms results. The knee angle signal (S_θ) is presented as reference.

signal. The resulting effect is moderate controllability, because the rate of flexion is also dependent upon load and knee position. However, the control system is very safe and dynamically stable.

2. The knee yielding rate is controlled so that the controller compensates for load or geometry variations. A preset angular velocity

AD-A070 587 VETERANS ADMINISTRATION WASHINGTON DC DEPT OF MEDICI--ETC F/G 5/2
BULLETIN OF PROSTHETICS RESEARCH. SPRING 1979,(U)
1979 E F MURPHY
UNCLASSIFIED BPR-10-31 NL

2 OF 6
AD
A070587



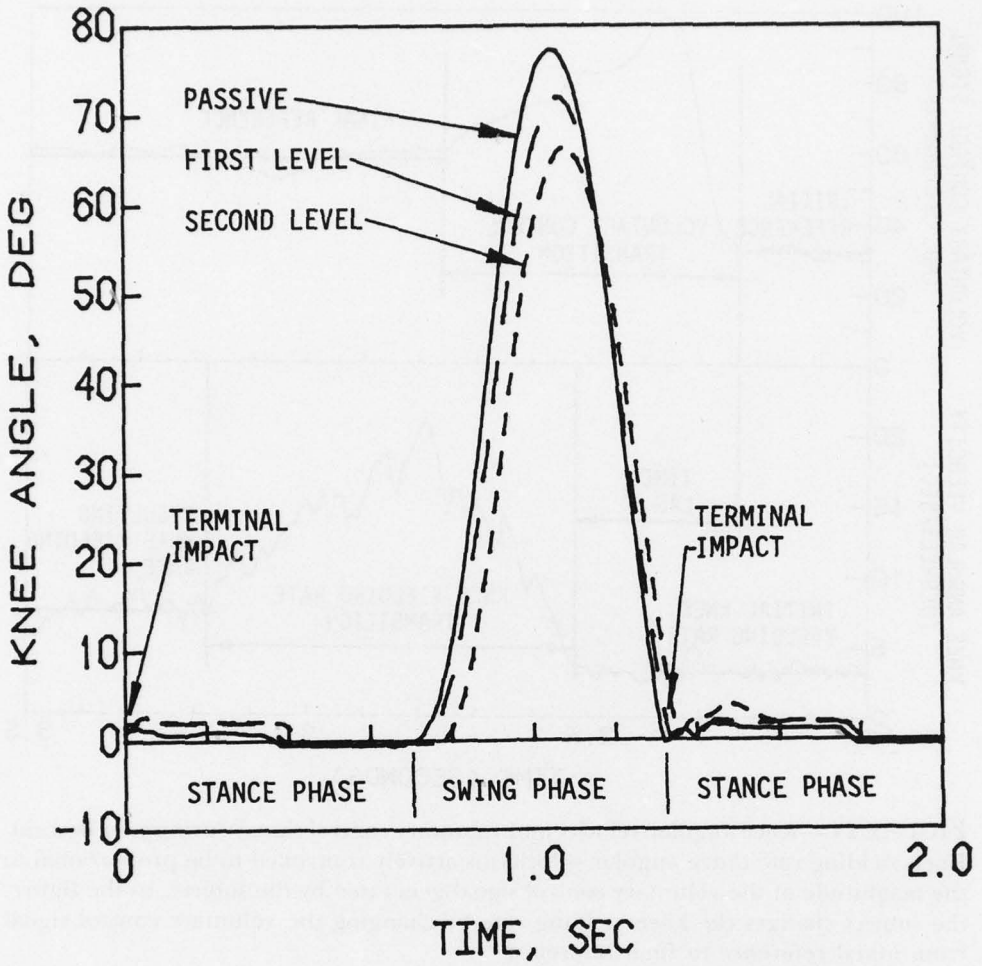


FIGURE 23.—Effect of swing-phase control on knee angle during swing phase. Maximum knee-flexion angle in swing phase is largest when small passive resistance to swing phase is applied (fixed swing-phase control setting). Maximum knee-flexion angle is reduced when swing-phase resistance is actively controlled (first level). Maximum knee-flexion angle is further reduced when higher active swing-phase control resistance is applied (second level).

was selected so that the knee always yielded at the same rate while descending stairs. This method is least controllable by the subject, but if a good preset value is selected it is effective. However, the designer feels that more control by the amputee would be desirable.

3. The knee yielding rate was actively controlled to be proportional to the magnitude of the voluntary control signal generated by the subject. This method produced the best results (Fig. 24). The control algorithm is much more complicated than the first two methods, and there is a possibility for dynamic instability to develop: efforts to refine the control system to prevent dynamic instability are continuing.

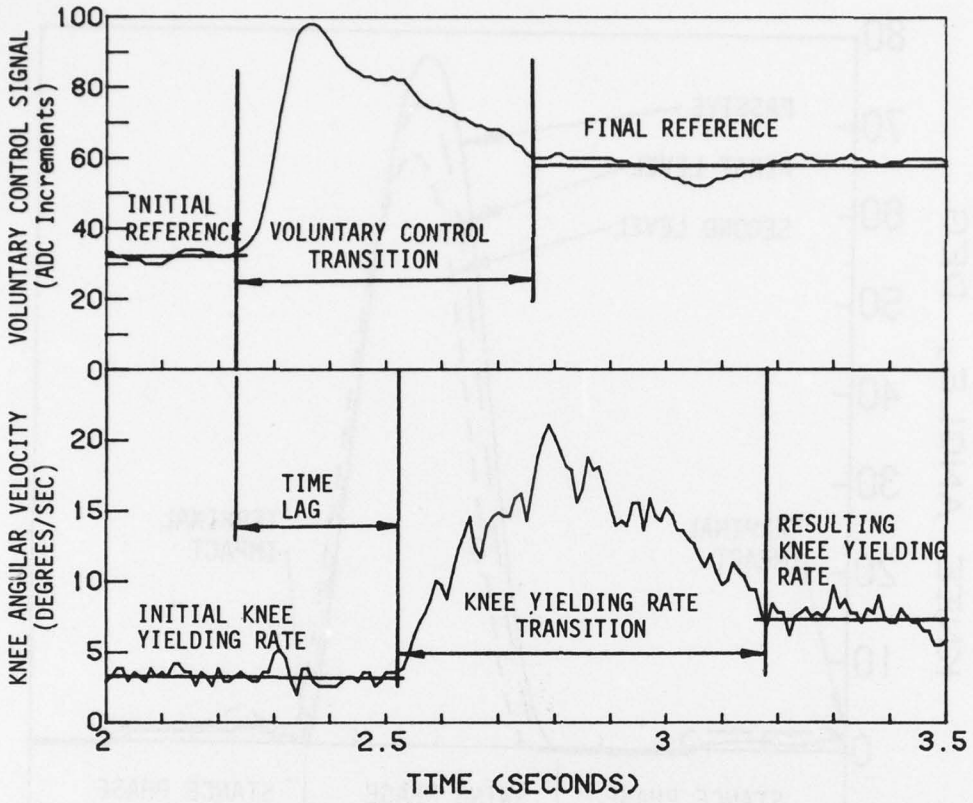


FIGURE 24.—Knee angular velocity and voluntary control signal during stair descent. Knee yielding rate (knee angular velocity) is actively controlled to be proportional to the magnitude of the voluntary control signal generated by the subject. In the figure, the subject changes the knee yielding rate by changing the voluntary control signal from initial reference to final reference.

A second stage of research into multi-input control of knee stability is currently underway. The objective of this stage is to further refine the computer control of knee stability, and to produce a compact and portable experimental unit so that the scope of testing can be expanded.

Clinical Evaluation of Lower-Limb Prosthetic Devices

In October 1978, a cooperative project was initiated between the UC-Biomechanics Laboratory and the San Francisco VA Medical Center (Fort Miley) for the purpose of expediting clinical tests of new prosthetic devices and components on VA patients.

An evaluation laboratory is being developed at Fort Miley where selected gait-assessment procedures developed in Berkeley will be used for routine clinical gait evaluation of amputees and other patients with locomotor disabilities. An orthopedic surgeon has joined the staff at Fort Miley, specifically to direct the project. Engineers from Berkeley have been actively involved in planning, and have been

attending orthopedic rounds on a regular basis in order to become familiar with clinical problems encountered at Ft. Miley.

Plans for space, equipment, and staff are progressing rapidly. Space renovations for the new facility are projected for completion before the end of FY 1979.

Mobility Aids for the Severely Disabled

PC2 Adjustable Height Wheelchair (formerly PRAHN II)

The first prototype of the PC2 wheelchair was essentially complete in September 1978, but delays in fabrication of brake parts have moved the expected commencement of daily-living testing to January 1979.

Spring Suspension Powering Unit (SSPU) Wheelchair

The second SSPU wheelchair is complete. It is being tested routinely in Berkeley.

Spring Suspension Wheelchair

Design work has begun on a wheelchair incorporating the high performance and spring suspension features of the PC2 and SSPU wheelchairs, but with a simple frame designed for ruggedness and low cost. A prototype is expected by August 1979.

Spring Suspension Forks

Two pairs of spring suspension forks have been fabricated, one with vertical telescoping action, and another with a swing arm pivoted above and in front of the wheel. Initial tests indicate that the swing arm design provides a better ride because it is better suited to absorbing horizontal impacts. A refined version of the swing arm design is scheduled for completion by August 1979.

Lever Drive System

Design work has begun on a lever drive system for manual wheelchairs with a feasibility prototype expected by August 1979.

Manual Chair Spring Suspension

A manual wheelchair spring suspension has been designed which will minimize drive energy absorption by the suspension system. A feasibility prototype is expected by March 1979.

Ultralight Below-Knee Prosthesis

Rehabilitation Engineering Center, Moss Rehabilitation Hospital
12th Street and Tabor Road, Philadelphia, Pennsylvania 19141
A. Bennett Wilson, Jr. and Charles M. Pritham, C.P.

More than 36 BK amputees have been provided with ultralight prostheses by the six participating private prosthetics facilities. Most of the prescriptions were provided by the VA Regional Office Amputee Clinic, Philadelphia, Pa. Some new patients have also been included.

The evaluation is done by personally administered questionnaires which concern the opinions of the patients and the prosthetists regarding the new design. Initial results indicate that the prosthesis-experienced amputees unanimously prefer the lighter weight of the polypropylene prosthesis. The major patient complaints have concerned the cosmesis of the prosthesis and the rigidity of the foot. Prosthetists feel that weight reduction is beneficial. Structural failure at the foot (with very heavy patients), mainly at the welded seams, have occurred; it is conceded that this has been due to poor technique. Another complaint is that the finished polypropylene prosthesis cannot be modified as easily as a conventional one.

Experience to date indicates that the ultralight BK prosthesis has a definite role in management of BK amputees, and research is continuing at the REC in an effort to alleviate the problems encountered with the present design.

The British Ministry of Health intends to conduct a large scale evaluation of the ultralight BK prosthesis in the very near future, because of extremely favorable results obtained in a pilot study.

An interim report will be issued by this REC shortly after January 1, 1979 and a final report will be made about June 30, 1979, so as to include relatively long-term results on all of the subjects used in the study. In addition, a revised manual will be made available.

Immediate Postoperative Prostheses Research Study

Prosthetics Research Study
Eklind Hall, Room 409, 1102 Columbia Street
Seattle, Washington 98104
Ernest M. Burgess, M.D.

During the calendar year 1978, a number of continuing research activities were terminated by data accrual and scientific publication. At year end, ongoing PRS research is as follows:

The Vascular and Nutritional Status of the Ischemic Limb

Upon completion and publication of the $Xenon_{133}$ study (Holloway,

G., and E. Burgess,: Cutaneous Blood Flow and Its Relation to Healing of Below Knee Amputation. Surgery, Gynecology and Obstetrics, 146, 750-56, May 1978) this investigation has been extended to include additional promising laboratory screening techniques. Following the accepted routine medical and vascular workup, the patient is referred for cutaneous blood flow studies to include: a. segmental Doppler, b. Laser Doppler, c. $Xenon_{133}$, and d. transcutaneous pO_2 saturation. These four laboratory observations are made at a number of sites in the threatened limb. Of particular interest is the development of the Laser Doppler, a non-invasive determinant with potentially high correlation to clinical wound healing. Associated with the PRS staff in this study are Drs. Allen Holloway, F.A. Matsen, III, and Brian Thiel, and a fulltime technician, Charles Simmons. The latter is employed by PRS.

During 1979 it is our plan to process, preoperatively, a minimum of 100 patients scheduled for amputation or vascular reconstruction. Collected data will be related to normal controls.

Clinical wound healing following amputation should define, with greater accuracy, the lowest appropriate level at which amputation can be successfully performed with primary wound healing. We believe this to be the most comprehensive investigation of this type being carried out in this country. An extension of these studies will include data accrual under a variety of physical modifications including varying degrees of external pressure application, local changes in skin temperature, and limb position relative to the trunk.

Functional Capabilities of Residual Below-Knee Limbs

A computerized liquid-displacement-volume and contour study is underway, with five subjects at present under study. The protocol includes biweekly measurements on the five subjects. In addition to the volume/contour measurements, the EMG activity of residual limb muscles, the prosthetic retention capability, and an analysis of gait are performed on each subject. This work is an extension of our previously reported studies into physiological suspension and the use of photogrammetry and CAT scanning to improve prosthetic socket design.

Each of the five subjects now under study carries out a closely monitored residual limb muscle rehabilitation program, directed by B. Kegel, Research Physical Therapist. Included are residual limb resistive exercises using an air compression source and also biofeedback techniques. The protocol runs for a period of 3 months with each amputee. Surgical techniques, rehabilitation methods, and prosthetic design can be related to the research findings.

Recreational Activities and "Quality of Life"

The studies conducted with Miller, Hutton, Enoka, Burgess and Frankel at the Department of Physical Education, University of Washington, have now appeared in three individual monographs. These relate to the biomechanics of amputee running. The studies are now being extended to other forms of physical activity and skills relevant to recreational pursuits. There is intense lay interest in this work. One of our amputees, a unilateral below-knee individual, climbed two high Western glacier mountain peaks this past summer, including Mt. Rainier (14,500 ft). He carried a 70-lb pack on his back, with equipment including a pair of short skis. His custom BK prosthesis was made according to bioengineering principles derived from previous PRS research. These studies have been extended to include a wide spectrum of sports and recreational activities for amputees.

Clinical Amputee Service, Seattle VA Medical Center

PRS continues to supervise and direct the Amputee Center and Amputation Service in Seattle, both inpatient and outpatient. The inpatient service averages ten major amputations per month at this time. Weekly outpatient clinics handle 15 to 25 patients each session. The service is actively engaged in teaching both locally and nationally. It also forms the clinical base for PRS investigation.

Below-Knee Amputation with Immediate Postoperative Fitting of Prosthesis

Tucson VA Medical Center
Tucson, Arizona 85723
Wesley S. Moore, M.D.

During the past 6 months we have made plans to construct and equip a Prosthetics Research Laboratory. We've also recruited a full-time Research Prosthetist for the project. The contract for remodeling of the laboratory space was let, and the remodeling program is in full activity. We contemplate a completion date of February 1, 1979 for the laboratory. Equipping the laboratory will occur shortly thereafter.

With availability of a full-time prosthetist, institutional approval by the Human Studies Committee has been obtained for resuming the randomized study of Immediate Postoperative Prosthesis vs. the Controlled Environment Treatment Unit for the initial management of the lower-limb amputee following surgery.

Finally, plans are well along for the development of the pilot program to establish a Regional Referral Center for Amputation.

Hemodynamic Evaluation of Postoperative and Preoperative Amputees

Castle Point VA Medical Center
Castle Point, New York 12511
Bok Y. Lee, M.D., Frieda S. Trainor Ph. D., David Kavner, D. Eng., and John L. Madden, M.D.

In the previous progress report (BPR 10-30, Fall 1978) on the use of noninvasive techniques as an aid in the selection of amputation level, use of the technique of photoplethysmography was shown to play an important role. Continued experience with the use of the photoplethysmograph has led us to the evaluation of its use in determining healing potentials of ischemic ulcerations and decubitus ulcerations. Initial work has been completed and forms the subject of this report.

In a series of 50 patients, the photoplethysmograph was used to evaluate the cutaneous circulation around the ulcer site during the course of a conservative management program. Four readings were taken at 1-cm intervals from the edge of the ulcer in each of four directions: four readings anterior, four readings posterior, four readings superior, and four readings inferior.

During the conservative management program, those patients who exhibited clinical evidence of healing were noted to also exhibit excellent pulsatile cutaneous blood flow, indicative of good tissue perfusion, as evidenced by the pulsatile waveforms obtained through the use of the photoplethysmograph.

Patients whose ulcers were not noted to exhibit clinical evidence of healing showed an absence of pulsatile cutaneous blood flow, indicative of poor tissue perfusion, as shown by a lack of pulsatile waveforms using the photoplethysmograph.

In patients evaluated at the start of the conservative management program, a prediction as to whether the ulcer would heal or not could be made on the basis of the photoplethysmographic tracings. Patients whose ulcers exhibited good pulsatile waveforms at the beginning of the conservative management program were predicted to have a good healing potential, and these ulcers were found to heal spontaneously. In contrast, ulcers exhibiting poor pulsatile waveforms at the start of the conservative management program were predicted to have poor healing potentials—and were found to be not healing after a prolonged conservative management program. They required surgical intervention to facilitate healing.

It appears that photoplethysmographic evaluation of cutaneous blood flow to an ulcer site provides a reliable indication as to the ulcer's healing potential. This effectively eliminates prolonged wait-

ing periods necessary before clinical signs of healing or nonhealing become evident. Ulcers with good pulsatile cutaneous blood flow have good healing potential and conservative management should be continued. Ulcers with poor pulsatile cutaneous blood flow have poor healing potential and would require prompt surgical intervention to facilitate healing.

Engineering Applications in Orthotic and Prosthetic Treatment of Musculoskeletal Defects

Motion Study Laboratory
Rehabilitation Medicine Service
Cleveland VA Medical Center
10701 East Boulevard
Wade Park, Cleveland, Ohio 44106
E. Byron Marsolais, M.D., Ph. D.

Dr. Herman J. Woltring joined the laboratory in September 1978 through the Case Western Reserve University Department of Orthopaedics, and has accelerated our efforts to make the Selspot system functional in gait analysis. He has reviewed our entire laboratory data acquisition system, and has taken our Selspot equipment back to Sweden for adjustment. He has also implemented much of his previously developed orientation software into our computer system. At this point in the development, we feel confident that we will be able to reach a reasonable level of accuracy in 3-dimensional gait analysis with the Selspot system.

The clinical laboratory is continuing to function well. We have managed to implement a computer-generated clinical report which is currently being evaluated in our Medical Center. Initial evaluation indicates that the clinicians are able to utilize the report and find it valuable in making clinical decisions and evaluating the effects of various types of therapy.

The clinical laboratory data on the total joint is currently being reviewed. Additional wire electrode implants have been made in the gluteus maximus and quadriceps in two patients with flexion contractures, with some reduction of the contractures in both patients through electrical exercise.

The microprocessor stimulator construction is continuing (on contract with Case Western Reserve University) and we are looking forward to using it to augment hemiplegic gait.

Patient Evaluation of a Functional Electrical Stimulation Hand Orthosis

Cleveland VA Medical Center

10701 East Boulevard
Wade Park, Cleveland, Ohio 44106
P. Hunter Peckham, Ph. D.

Introduction

The purpose of this project is to develop and evaluate the effectiveness of upper-limb orthotic systems actuated by electrically stimulated paralyzed muscle. The focus of the present research is on a system designed to provide controlled grasp and release of the hand, through electrical stimulation of paralyzed forearm finger flexor and extensor muscles. The system has been described in detail in previous reports (BPR 10-28, 10-29, 10-30).

Hardware Development

The complete system that has been developed is shown in Figure 25. Position of either the shoulder (shown) or head supplies the proportional command which governs the strength of contraction by varying the stimulus pulse width and frequency delivered to the muscle. On/off and hold commands are controlled by a myoelectric signal. A wrist-hand orthosis is used to stabilize wrist, thumb, and interphalangeal joints of the fingers.

Fabrication of three stimulators has been completed (Fig. 26) and two have been fitted to subjects for outpatient evaluation (see below). One system incorporates the shoulder position controller (Fig. 25), redesigned by the Case Western Reserve University Rehabilitation Engineering Center. The transducer, which senses movement in the sensing rod as a change in magnetic coupling, required minor alterations in the input electronics of the stimulator. The second system utilizes head position for the proportional command source. In this period, this transducer has been redesigned to fit inside a conventional behind-the-ear hearing aid chassis (Fig. 27). The audio transducer from the hearing aid is retained and used to supply audio feedback signals to the subject. The position transducer fits in the remaining space behind the audio transducer. The transducer functions as a damped pendulum. Movement from the gravity vector during flexion and extension of the neck is sensed by strain elements which are mounted on a thin shim with a pendulous lead mass at the end. The pendulum is then damped by immersion in silicone fluid. The transducer, housed in the hearing aid body, is simply mounted and appears to be mechanically stable and cosmetically appealing.

Patient Studies

Three subjects are active at present in the development and evaluation of this system. All patients are young males (ages 21 to 27 yr) who sustained spinal cord injury and have motor function at the C-5 level.



FIGURE 25.—Stimulation system showing shoulder position controller and audio feedback transducer (on chest), reference electrode (around humerus), surface connector and lead wire to finger extensor electrodes and orthosis. The stimulator is behind the subject's left hand. The connector for the MES site is over the left biceps and is not shown. During use, clothing covers the majority of this system.

Each has voluntary strength and sensation which is greater in one arm than the other. In the stronger arm, each has shoulder flexion, shoul-

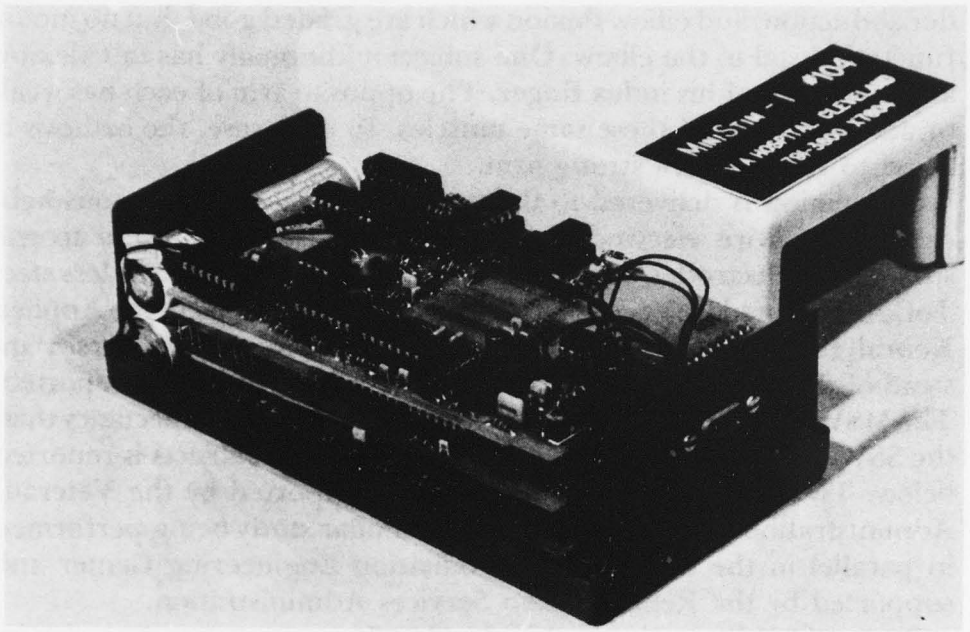


FIGURE 26.—Stimulator package. The device is battery powered with overall dimensions of 6 in × 3 in × 2 in.

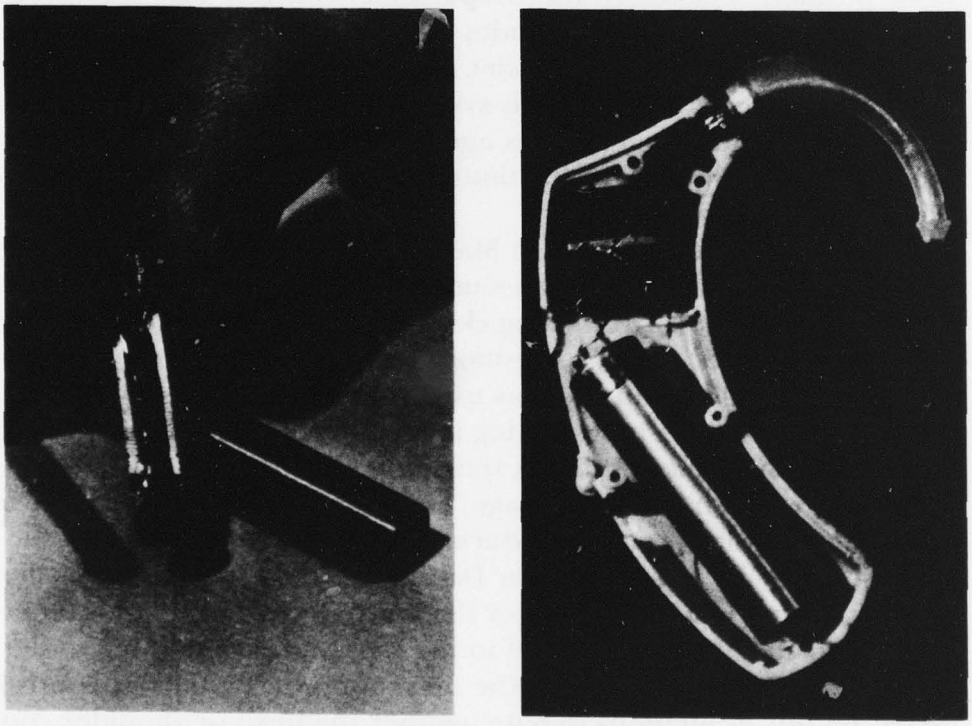


FIGURE 27.—Head position transducer. At left, strain gage mounted on shim material with pendulous lead mass; fluid fills the capsule and provides damping of the pendulum. At right, the mounting in a conventional behind-the-ear hearing-aid chassis (the aid's audio transducer is retained to supply audio feedback cues).

der abduction, and elbow flexion which are graded good, but no motor function distal to the elbow. One subject additionally has fair flexion and extension of his index finger. The opposite arm of each has weak or absent activity of these same muscles. In each case, the orthosis is fitted to the patient's strong arm.

Stimulation is delivered to the muscle through percutaneous helically coiled wire electrodes. In the past period, we began to use stimulating electrodes wound from ten-strand type 316 stainless steel Teflon-insulated wire (i.e., MSW electrodes), developed in the Applied Neural Control Laboratory at Case Western Reserve University instead of the single-strand wire electrodes (SSW) previously reported. The MSW electrodes are expected to have a longer life expectancy than the SSW. The results of the studies with the three subjects is reported below. Two subjects are from the study supported by the Veterans Administration and the third is from a similar study being performed in parallel in the C.W.R.U. Rehabilitation Engineering Center and supported by the Rehabilitation Services Administration.

Patient M.V.R. was injured in April 1975 in a motorcycle accident. He was fitted with the first stimulation system in July 1978, after having worked with a prototype system for 24 months. He uses the head position transducer for proportional control, and chronically indwelling percutaneous electrodes in his contralateral biceps for the myoelectric source. A metal splint is used to stabilize the wrist and hand. This subject was using his system regularly for 1 month while attending college, but 3 months ago he dropped out of college and usage has been limited to situations in the home when his independence was important to him.

Subject J.H.L. was injured in May, 1973, in a diving accident. He uses the shoulder position transducer for proportional control, and also uses percutaneous recording electrodes in his contralateral biceps for the myoelectric signal acquisition. He received the second system in September 1978, and also has used it periodically since that time, primarily in instances necessitating independence. He has been out of college for one semester, but is returning again in January 1979. At that time he anticipates daily usage, as was our previous experience in his use of a prototype system during similar circumstances.

Subject T.V.D. was injured in December, 1974, due to a gunshot wound. He has weak index finger flexion and extension, but is otherwise completely paralyzed distal to the elbow. He is presently undergoing evaluation to determine the most appropriate type of control. Based on our evaluations to date, neither the head or shoulder control may be appropriate. This is because he is able to grasp quite rapidly and accurately many lightweight objects, without applying stimulation, when his hand is in a wrist-driven prehension orthosis to guide his finger movement. Therefore his control needs appear

primarily the ability to augment his weak grasp, for which rapid change in the command may not be imperative. This control situation is similar to that reported below in a system under development for C-6 quadriplegic patients; T.V.D. is being evaluated with this same type of control.

Results

Initial feasibility studies, performed in conjunction with the Applied Neural Control Laboratory at C.W.R.U., have been completed. These studies have demonstrated that functional lateral pinch was provided over a full range of wrist positions by electrical stimulation of the appropriate muscles, that thumb extension was useful, especially in grasping large or lightweight objects, and that the control required only a relatively slow change from flexion to extension but that proportional control was still necessary. No external orthosis was needed to guide proper motion of the hand. Sufficient control was provided by a myoelectric signal (MES) in which the processed (rectified and averaged) signal controlled the stimulator output proportionally in time. That is, two levels of the MES were sensed; exceeding the lower level resulted in an increase or decrease in the command in proportion to the duration of time that the level was held; exceeding the upper level changed the direction of the change in command (i.e. from increasing to decreasing, or vice versa); signals below the lower level did not change the command.

This means of control is presently being implemented in the miniature stimulators, and will be evaluated as the command control source for subject T.V.D., as well as three C-6 patients who are presently associated with this program.

Lateral Pinch and Release in the C-6 Quadriplegic

The purpose of this project is to develop a system to augment tenodesis grasp in the C-6 quadriplegic patient by electrical stimulation of the finger flexor, thumb abductor, and opponens pollicis to provide lateral pinch, and the extensor pollicis to provide release. The rationale for this approach is as follows: These subjects are able to manipulate various objects (especially eating and writing utensils), but are unable to hold them securely after they have positioned them properly. Thus, the patient must rely on special adaptive aids and splints which frequently are rejected after long-term followup. Through electrical stimulation of their paralyzed muscles, these tonic functions can be accomplished, and their need for an external orthosis in these tasks may be eliminated.

Research and Development Project on Advanced Orthotic Devices for Adult Paraplegics

Prast Research Associates, Inc.
1094 Stony Point Road
Grand Island, New York 14072
Martin T. Prast

Department of Engineering Design and Economic Evaluation
Engineering Center OT 6-34, University of Colorado
Boulder, Colorado 80302
Lawrence E. Carlson, Ph.D.

As reported in BPR 10-30, Fall 1978, certain design weaknesses in the self-locking knee locks (capstan knee locks) were discovered in PACO III. Redesign of that portion of the PACO system is presently in progress. When this has been accomplished PACO III will be further evaluated.

Studies of Normal and Abnormal Motion

Kinesiology Research Laboratory
Wood VA Medical Center, Wood, Wisconsin 33193
Mary Patricia Murray, Ph.D.

No report was submitted for this period. A full report will appear in the next issue.

Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects

Nashville VA Medical Center
1310 24th Avenue South, Nashville, Tennessee 37203
Paul P. Griffin, M.D., Richard Shiavi, Ph.D., Sherry Champion, R.P.T., and Frank Freeman, M.D.

No report has been submitted for this period.

Functional Neuromuscular Stimulation of Limbs: A Feasibility Study

Brentwood VA Medical Center
Wilshire and Sawtelle Blvds.
Los Angeles, California 90073
John A. Foster, M.D. and Moshe Solomonow, Ph.D.

No report has been submitted for this period.

Evaluation of Electrical Techniques for Stimulation of Hard Tissue Growth

Syracuse VA Medical Center
Irving Avenue and University Place
Syracuse, New York 13210
Robert O. Becker, M.D., J.A. Spadaro, Ph.D., and A.A. Marino, Ph.D.

The Orthopedic Laboratory has continued to expand its evaluation of the clinical efficacy of electrically injected silver ions as a local bactericidal agent.

Since July 1978, eight new cases have been added to the series, for a total of 22 since the clinical phase of the program began. A full report on the first 16 cases was recently published (Journal of Bone and Joint Surgery, 60-A, 871-881, 1978) and this treatment was the subject of nationwide television news stories on two networks.

Dr. Becker and his group have found that, in the majority of cases, seven to ten days of treatment are sufficient to produce a bacteriologically sterile wound in cases of osteomyelitis of less than seven years duration. Longer term cases, with marked osteosclerosis extending over large areas of the involved bone, may be controlled and become surgically clean wounds, but cannot be rendered sterile with present techniques.

A new extension of the technique has been under study for the past two months. In those cases in which a sterile wound can be attained, open bone grafting has been done following two successive sterile cultures. The bone graft is protected by a layer of silver nylon material applied directly over it in the operating room. This material is also made electrically active and serves as a barrier to contamination of the graft site.

A recent observation has indicated that the silver anode also has a major regeneration stimulating effect upon bone marrow elements. This observation will be followed up in detail in 1979.

Expanded clinical testing of the electrically injected silver in osteomyelitis and other local recalcitrant infections is being planned to begin in May 1979 at a number of clinical centers outside of Syracuse.

Other aspects of bioelectrical treatment and basic research into bioelectronics continue at the Syracuse laboratory.

Acceleration of Bone Healing by Electrical Stimulation

Helen Hayes Hospital Biomechanics Research Unit
Route 9-W, West Haverstraw, New York 10933
George Van B. Cochran, M.D.

No report has been submitted for this period.

Orthopedic Implant Device Retrieval and Analysis

New Orleans VA Medical Center
New Orleans, Louisiana 70146
Allan M. Weinstein, Ph.D.

In the last 6-month period (June to December 1978), 129 additional orthopaedic implants have been retrieved. Of these implants, 70 are bone plates, 34 are hip nail devices, and 25 are hip prostheses. For each device, specific information has been noted such as patient name, hospital, manufacturer, implant site, duration of service, and condition as received. In addition, a metallurgical examination has been initiated for each device. Macroscopic examination yielded information regarding type and location of mechanical damage. Wear and burnishing marks as well as gouges produced by the surgical procedure were carefully noted.

The type and degree of corrosion was determined by macroscopic and microscopic examination. The severity of the corrosion was indexed on a scale of 0–5, with 0 representing no visible corrosion and 5 representing very severe corrosion. Results show that all of the 97 stainless steel screw and plate implants exhibited corrosion. Crevice and pitting were the most common types of corrosion found. Only one of the seven Co-Cr-Mo screw plate implants had undergone corrosion.

In the case of mechanically fractured implants, the failure mode was determined where possible and recorded.

Rockwell hardness measurements were made for each implant. The hardness values ranged from $R_B61.1$ to $R_C37.9$.

Clinical data such as operative reports and histological and radiographical findings are being collected from the appropriate hospitals. Finally, tests to determine the bend and fatigue strengths of the implants are now underway.

In Vitro and In Vivo Quantitative Analysis of Acetabular Failure in Total Hip Arthroplasty

Gainesville VA Medical Center
Gainesville, Florida 32602
William Petty, M.D.

Total hip arthroplasty is a development with marked impact on the treatment of hip disease. One complication of the procedure has been loss of bony support and displacement of the arthroplasty acetabular component. Causes of this complication include previous acetabular fracture, protrusio acetabulum, and over-reaming of the acetabulum at the time of arthroplasty. Protrusio acetabulum due to any cause may be responsible for inadequate bony support of the acetabular component. Treatment of displaced acetabular components or protrusio acetabulum has included attempts at achieving stability of the prosthetic acetabulum by increasing the amount of bone cement and/or reinforcing the cement with metalllic mesh or other reinforcing devices. Establishing bony support with bone graft has also been suggested.

The objectives of the research are to determine the effect of reaming of the bony acetabulum on the strength of the pelvis-and-prosthetic acetabulum complex, and to determine the efficacy of various reinforcing devices to establish solid support of the prosthetic acetabulum.

Paired human cadaveric hemipelves are instrumented with strain gages, which sense microscopic deformation in the bone. The pelves are loaded through femoral head prostheses to simulate the stance phase of gait, and the strain pattern in the vicinity of the acetabulum is recorded. Acetabular prostheses are then implanted and the bones loaded again as before, and the new strain pattern determined. The objective is to determine the changes in the strain (and consequently, the stress) patterns due to the presence of the prostheses, and to measure the effect of the depth of reaming on the strain pattern. Subsequent experiments will evaluate various techniques for reinforcing the weakened acetabulum.

Unfortunately, there has been considerable technical difficulty in the installation and balancing of the strain gages. Over the past 3 to 4 months, this problem has been, to a great extent, solved. The data reduction — that is, converting the raw data into useful information — is taking considerably more time than anticipated. Because of this, at the present time, the project is running at a rather slow pace. It is hoped that we will be able to obtain the use of an Autodata strain gage data logger to help in this very time consuming task.

It has been determined that there are marked changes in the strain

patterns of the bony pelvis following implantation of a total hip arthroplasty acetabular component. We have been unable to complete the experiments evaluating the effect of reaming depth, but we hope this will be completed in the near future. Then we may proceed with analysis of the various methods for reinforcing the bony pelvis-acetabular prosthetic component complex.

In Vivo Loading of Knee Joint Replacements

Orthopaedic Engineering Laboratory
Glennan Engineering Building
Case Western Reserve University
2040 Adelbert Road
Cleveland, Ohio 44106
Richard H. Brown, Ph. D., Kingsbury G. Heiple, M.D., and Victor M. Goldberg, M.D.

Background

Since our previous report, Fall 1978, in which the basic design of the telemeterized total knee joint tibial component was described, prototype bench testing of the unit has been undertaken. The results of this prototype testing were used to further refine the load cell to be incorporated in the tibial component, in order to optimize the load cell's measurement sensitivity in all desired modes while, at the same time, minimizing the load cell's overall deflection. The new load cell configuration resulting from this evaluation is shown in Figure 28. Included in this new design were the necessary clearance grooves for the wires used in constructing the measurement bridge circuitry.

Following completion of the load-cell design, the remaining components necessary to assemble a total tibial component were designed. The design of the tibial component implant housing is shown in Figure 29. The details of the housing/stem interface junction are shown in Figure 30, detail-section A-A. The third major structural component of the tibial component, the stem, is shown in Figure 31.

Prototypes of each of these major structural components of the telemeterized total knee femoral component have been built and evaluated. In addition, all required telemetry circuits have been developed and tested. To date, no major design problems have been encountered, nor are any anticipated at this time.

In addition, all required telemetry circuits have been developed and tested.

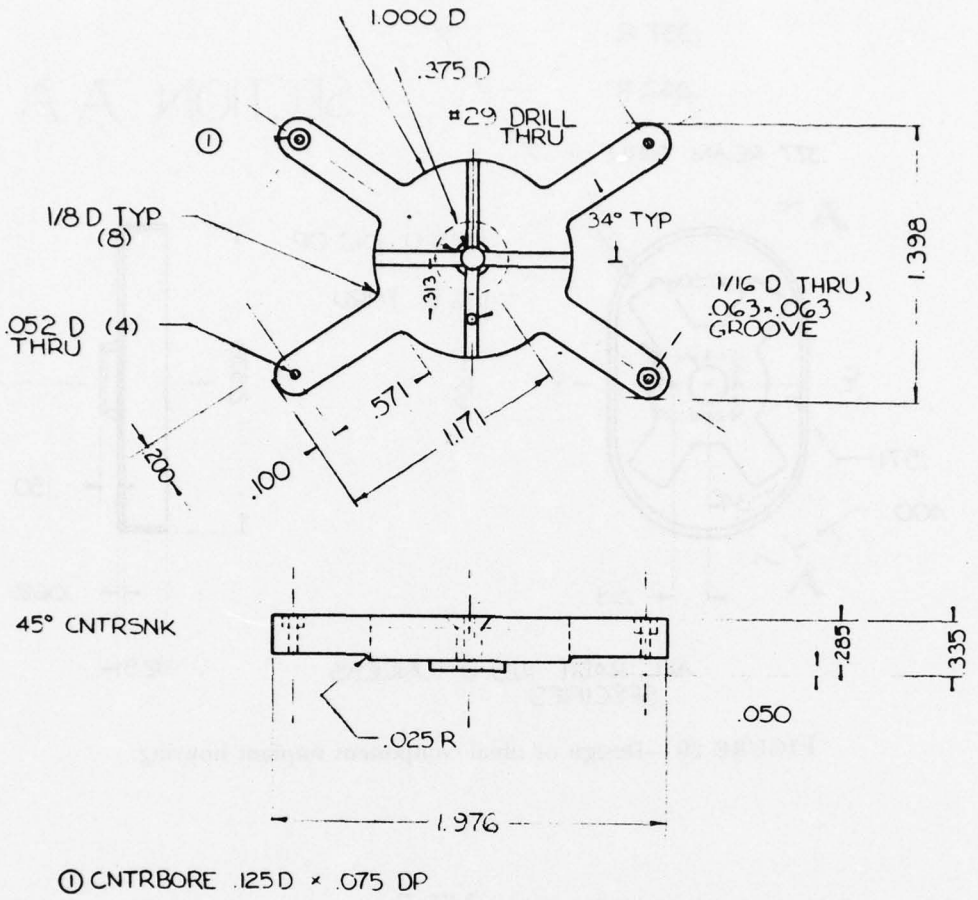


FIGURE 28.—New load-cell configuration designed to optimize the load-cell's measurement sensitivity in all desired modes while at the same time minimizing the load-cell's overall deflection.

Current Status

At the present time, the final prototype of the telemeterized total knee tibial component is being assembled. This unit will then be calibrated and subjected to rigorous mechanical testing. Barring any unexpected problems arising from this testing, it is still anticipated that a device will be ready for implant by the summer of 1979.

Mobility Engineering for the Severely Handicapped
Mobility Engineering and Development (MED), Inc.
7131 Havenhurst Avenue
Van Nuys, California 91405
Charles M. Scott and Ronald E. Prior, Ph. D.

Work during this period has been centered on preparing the van-compatible wheelchair for clinical evaluation. Two units have been

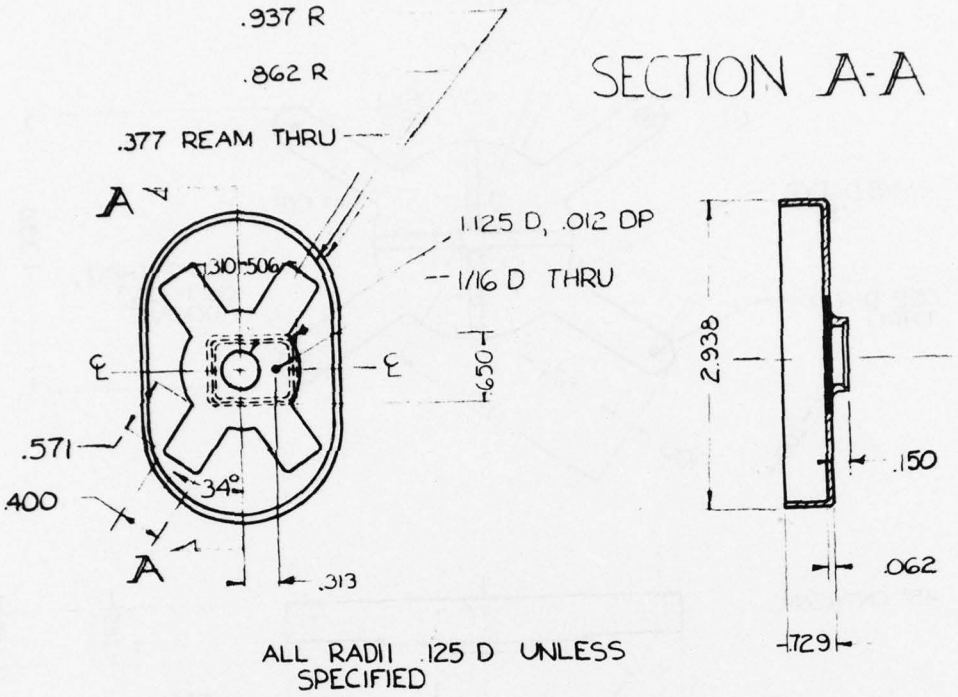


FIGURE 29.—Design of tibial component implant housing.

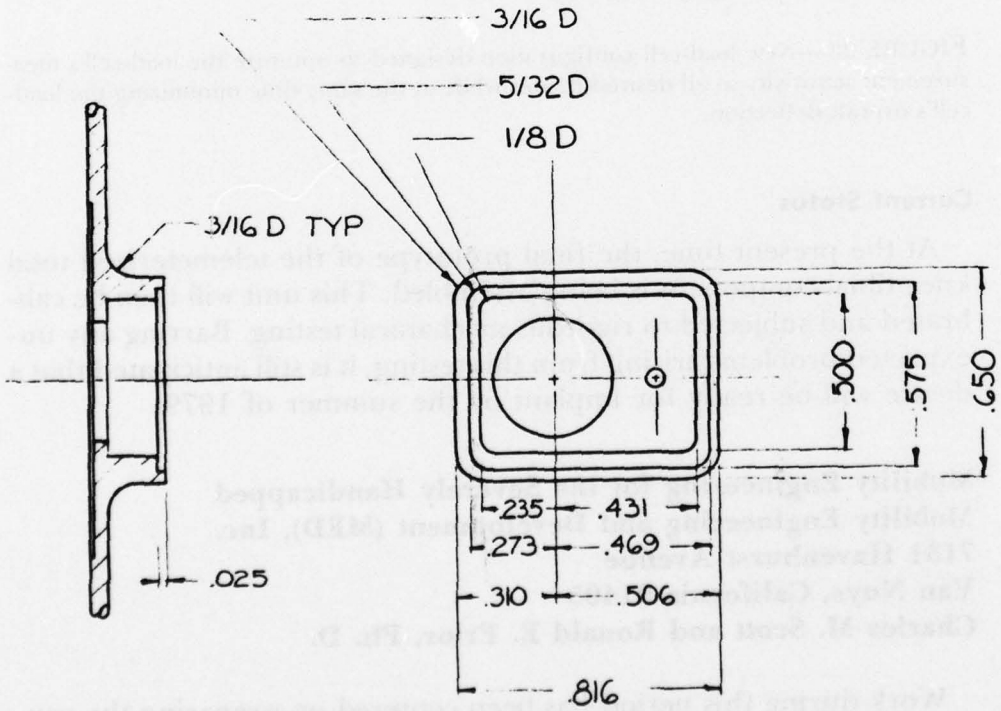


FIGURE 30.—Details of housing/stem interface junction (detail section A-A).

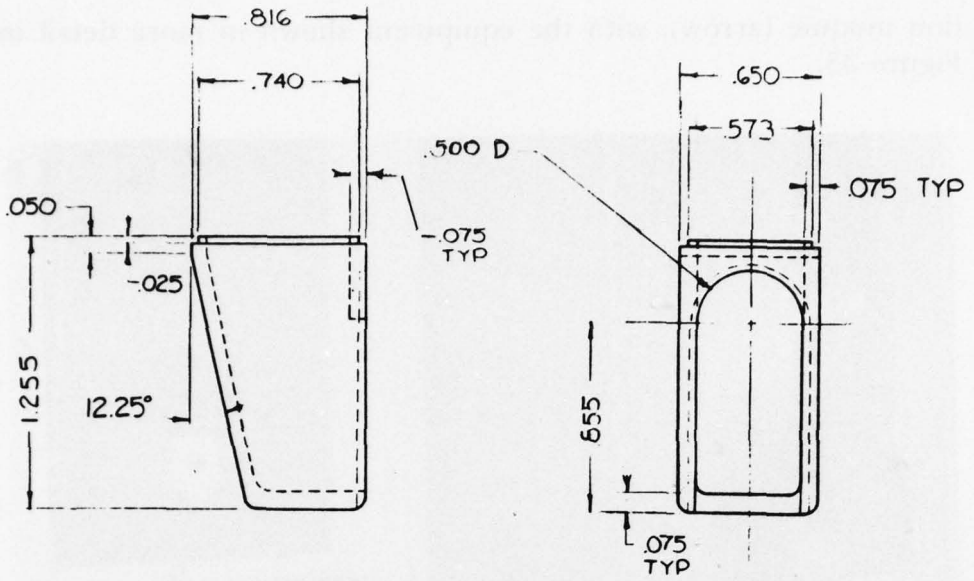


FIGURE 31.—Major structural component of the tibial component, the stem.

completed, one with power steering; the other with traditional castered front wheels. A third unit is nearing completion and will also have castered front wheels.

Development of a Wheelchair Using a Myoelectric Control System

West Roxbury VA Medical Center
1400 Veterans of Foreign Wars Parkway
West Roxbury, Massachusetts 02132
Alain B. Rossier, M.D., Mehdi Sarkarati, M.D.,
George E. Crawford, Ph. D., and Jonathan Dietz

During the period from July 1 through December 31, 1978, hardware improvements have been made on the simulated wheelchair control system. Testing has continued to include a total of four patients. Plans for continuing the investigation to include the development of control units for moving chairs have been made.

The simulated wheelchair control system basically consists of two myoelectric channels for detecting coded signals from the patient, electrical stimulation provisions for assisting the patient in timing his coded myoelectric activity, a visual display board for presenting the decoded wheelchair commands, and a microcomputer system for providing all the required decoding and control functions. This system is shown in Figure 32, including the surface electrode amplifica-

tion module (arrow), with the equipment shown in more detail in Figure 33.

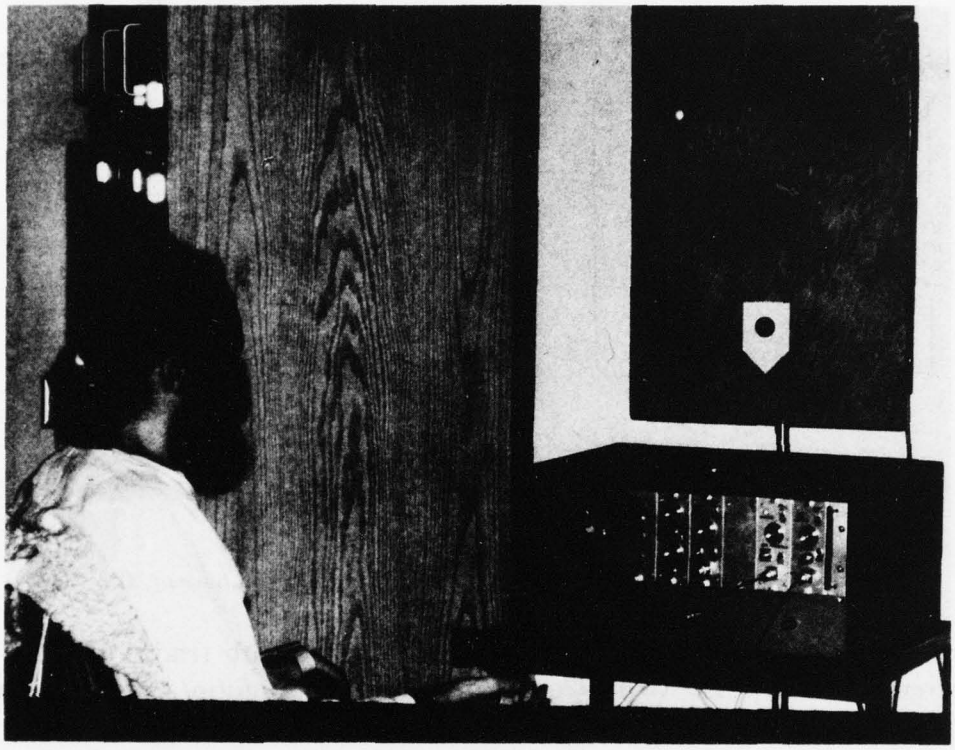


FIGURE 32.—Experimental myoelectric wheelchair control system.

During the development and early testing of the system, the microcomputer program was stored on magnetic tape and loaded into temporary RAM (random access memory) each time the system was used. During the current reporting period, all of the system memory hardware has been replaced with one 2708 EPROM (electrically programmable read only memory) integrated circuit. The program has been written such that the registers on board the microprocessor chip are sufficient for all the RAM required by the system.

Each of the four patients who have participated in this program has learned to operate the system after a few minutes of instruction. All four have shown significant improvement in proficiency (as indicated by speed of operation and error rate) after several hours of practice. The first step of the instruction procedure consists of familiarizing the patient with the generation of myoelectric activity. Provisions are made in the system hardware to facilitate this first step. The system can be switched to what is referred to as the Direct Feedback Mode. In this mode, the right half of the display board is illuminated whenever myoelectric activity in the right channel exceeds the

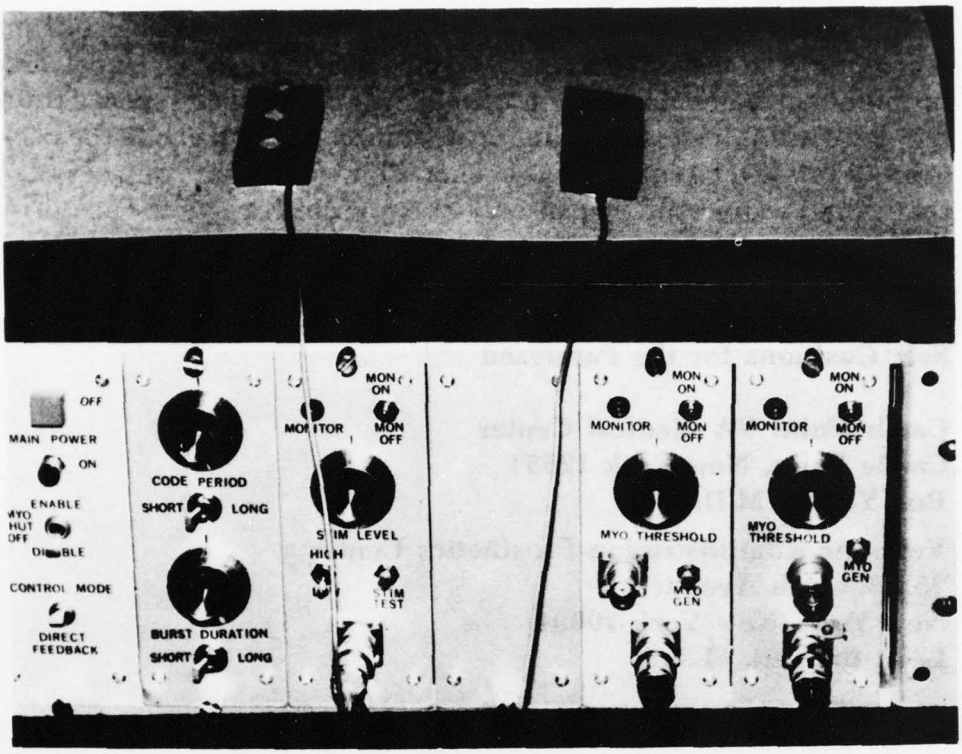


FIGURE 33. — Electronic apparatus used in the system of Figure 32.

detection threshold. The left half of the display board is similarly illuminated by the left channel activity. In this mode, the patient can directly learn to generate the myoelectric bursts used for coding commands without having to infer the results of his attempts at myoelectric burst generaton from the output of a decoding system. It has been found, in each of the four cases, that after a few minutes of practice in the Direct Feedback Mode the patient could independently initiate myoelectric activity on either channel at will.

After the short practice session in the Direct Feedback Mode, the coded sequence of myoelectric bursts required for each of the wheelchair commands is explained to the patient. Following this explanation, the system is switched to the normal Control Mode and the patient is asked to attempt to generate the different wheelchair commands. In each of the four cases, the patient could immediately generate the commands at the rate of approximately one command per second. After several hours of practice, each of the four patients could generate commands at a rate that would be adequate to control a moving wheelchair.

The positive results discussed above have led to plans to modify and repackage the system for convenient use as a wheelchair joy stick replacement. There are also plans to investigate a myoelectric coding

technique referred to as "biological microcoding." The object of microcoding is to increase the information rate that can be transferred by minute myoelectric bursts at the expense of requiring special training. Success in the microcoding investigation would provide the background for developing a second generation wheelchair control system that would require the use of only one myoelectric site for acquiring information at a rate sufficient for wheelchair control.

Seat Cushions for the Paralyzed

Castle Point VA Medical Center
Castle Point, New York 12551
Bok Y. Lee, M.D.

Veterans Administration Prosthetics Center
252 Seventh Avenue
New York, New York 10001
Leon Bennett, M.A.E.

An instrument has been prepared to measure the applied pressure, shear and arteriolar blood flow in the vicinity of the ischium of a seated wheelchair user. In essence, the instrument consists of a closely packaged array of sensors placed within a thick Lucite seat, which in turn is mounted to a wheelchair.

Our expectation is that this device will discern those loading conditions leading to skin blood flow occlusion (and by projection, decubiti) in a salient anatomical area. Hopefully, the contribution of shear forces to occlusion, long a matter of conjecture, will be clarified. Subjects displaying various pathologies (paralysis, amputation, geriatrics) will be tested to discern patterns of force vs. occlusion characteristics.

The instrumental array has been successfully tested previously, using the palms of healthy subjects, with results given in the Archives of Physical Medicine and Rehabilitation (In press).

Seating Systems for Body Support and Prevention of Tissue Trauma

Palo Alto VA Medical Center
3801 Miranda Avenue
Palo Alto, California 94304
Inder Perkash, M.D.

Stanford University
Children's Hospital
Rehabilitation Engineering Center

520 Willow Road
Palo Alto, California 94304
Maurice Le Blanc, C.P. and Wallace Motloch, C.O.

Since the last report (June 30, 1978) the main thrust of effort has been concentrated in four areas:

1. Modification of shape to provide pressure distribution consistent with the Maximum Allowable Pressures (as per Rancho Los Amigos Progress Report, 1975);
2. Fabrication of silicone mold for third-generation pour;
3. Pouring of ten cushions; and
4. Start of testing of new cushions at Palo Alto VA Medical Center, Spinal Cord Injury Center.

The initial trials of the new shape showed pressure readings in a much more acceptable range. Areas like bladder neck, coccyx, ischii and trochanters appear satisfactory but the posterior thigh pressures are still too low. To increase these posterior thigh pressures, Plastizote pads were laminated into the polyurethane foam (Fig. 34 and 35). The exact shape and size of these Plastizote pads is now being determined by experimentation.

Waterproofing the foam pad still remains a problem. To date the following approaches have been tried:

1. Polyurethane, self-skinning foam—the skin is not of good

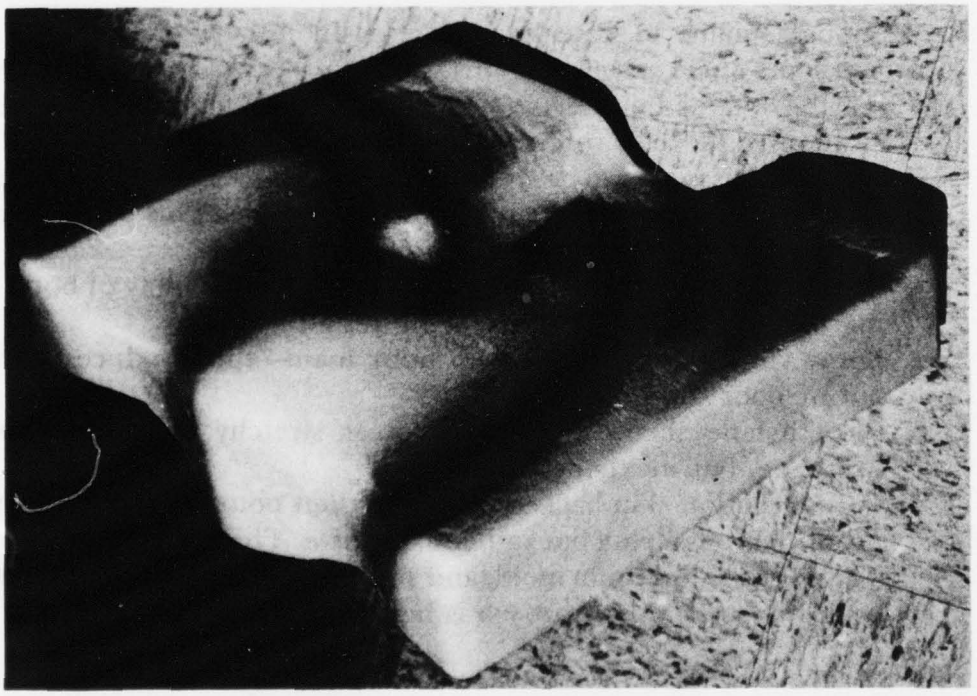


FIGURE 34.—Front view of VA contoured cushion.

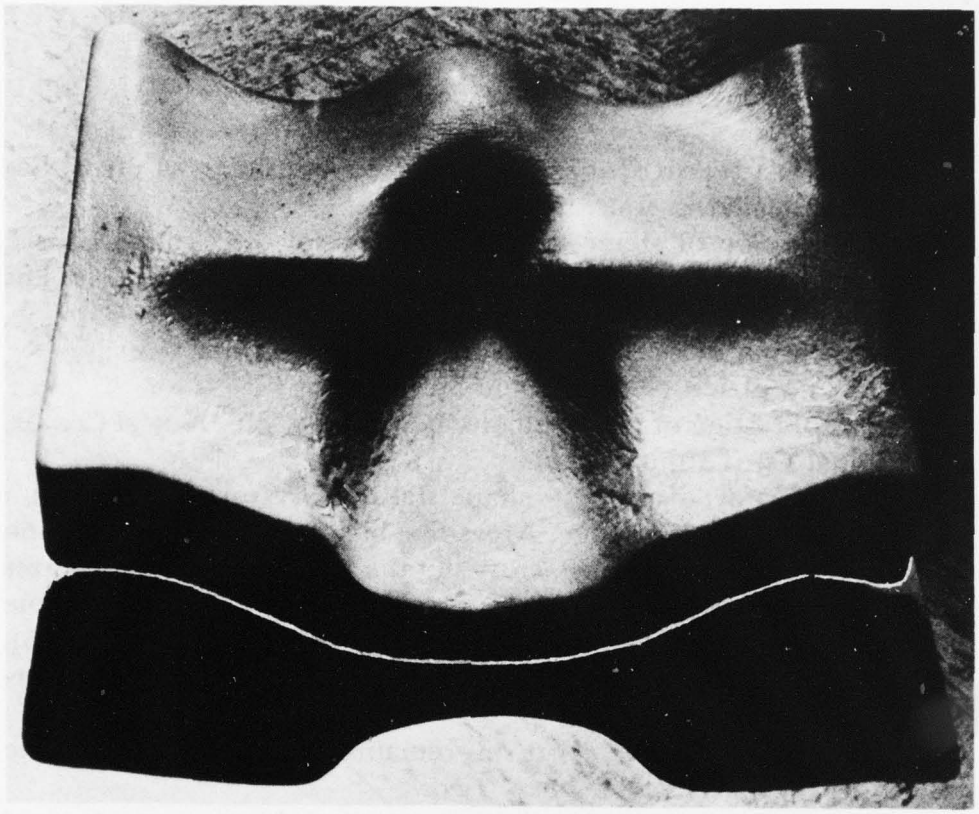


FIGURE 35.—Back view of VA contoured cushion.

enough quality to water-proof the cushion.

2. Urethane sheet envelope—this is an excellent material but can only be obtained in sheets. A cover that is an integral part of the cushion would be preferred.
3. Glove vinyl with two way stretch backing—is presently being used but has to be sewn up in upholstery style. This places the seams in the most undesirable locations.
4. Glued-on latex sheet—this is presently used. Durability of bonding agent and latex skin are being tested.
5. Spray vinyl skin in mold, then pour foam—this produces skin but of poor durability.
6. Polyethylene sheet envelopes—not as stretchy or durable as urethane, but inexpensive.
7. Porous Teflon skin backed on mold, then pour foam—this is a promising possibility but rather expensive. This process calls for a high-gloss aluminum mold, and since the cushion shape has not been finalized, this approach is being reserved for future use.

Publication

1. Progress Report Booklet: 4/1/77–9/30/77, Children's Hospital at Stanford, 520 Willow Road, Palo Alto, California, 94304.

Maxillofacial Restorative Materials and Techniques

Maxillofacial Research
Temple University School of Dentistry
Broad Street and Montgomery Avenue
Philadelphia, Pennsylvania 19122

Wilmington VA Medical Center
1601 Kirkwood Highway
Wilmington, Delaware 19805

John F. Lontz, Ph. D., and James W. Schweiger, D.D.S., M.S.

Polydimethyl siloxane (PDM siloxane for short) continues to rank unequivocally as the biomaterial of choice for maxillofacial reconstructions on the basis of:

a. chemical and biological resistance,

b. exceptional tear resistance much like that of physiological tissue, and

c. continued demonstrated non-toxicity in the human excised donor (HED) tissue toxicity testing program.

The research and development program on PDM siloxane continues along the broad front of five principal programs of the Comprehensive Development Plan listed in a previous report (1) and presently augmented by a sixth, highly essential program, namely, VI Production, for which equipment and facilities have been set up at the Wilmington Veterans Administration Medical Center.

Status of Comprehensive Program

The setting up of the production facilities for PDM siloxane pigmented stocks, within the direct control of the overall project rather than depending, even initially, upon extramural production or even small-lot preparations in separate clinics or centers for maxillofacial reconstruction, is deemed highly desirable for two reasons.

The first reason is that a need exists for rapid dissemination of the PDM siloxane of uniform test quality to widened familiarization, usage, and standardization of safe and effective prosthetic reconstructions throughout the VA system. Therefore, one-pound lots of intrinsic pigmented stocks are being made available to all VA clinics (and to certain non-VA prosthetic clinics, some of which service veteran patients — this wider dissemination will permit much more extensive feedback of clinical results).

Second, this chemically identifiable PDM siloxane, in view of its proven non-toxicity on orofacial HED tissues (2), is being extended from its initial biomaterial role in externally affixed prosthetic maxillofacial reconstruction to internal insertives and implants in direct and

indefinite contact with sensitive mucosal lining and tissues. In this regard, interest has been indicated for use as esophageal inserts, linings to replace dura mater especially in pediatric cases, otological membranes, and so on.

While the competitive biomaterials for maxillofacial prostheses, notably those derived from polyvinyl chloride plastisols (3) and polyurethanes (4), continue to serve usefully in maxillofacial reconstruction, severe limitations with regard to durability and safety to mucosal tissues have become evident (5, 6). While some of the limitations of the competitive prosthetic polymers can be ascribed to innate deficiency in chemical resistance, a major share of the limitations and shortcomings in safety and durability (as now being prescribed by the recently enacted New Medical Devices Act of 1976) (7) can be ascribed to lack of materials standardizations for quality and purity, and to lack of formulations to replicate tissue elasticity (8) and cosmetic matching (9). Thus the production program now in progress is aimed toward control and standardization of chemically identifiable PDM siloxane as an effective and durable prosthetic material, to include orofacial and not just maxillofacial reconstructions, and as a proven non-toxic biomaterial under current statutory FDA requirements.

I. Product Development Program

This phase of the Comprehensive Development Plan has been directed toward assessing durability of PDM siloxane, in comparison with competitive materials, by a battery of end-use tests that would anticipate the likely or possible deterioration in long-term, indefinite usage. For this assessment a battery of exposure conditions has been devised, using the test description and conditions listed in Table 1. From these, appropriate quality standards much like those promulgated by the American Society for Testing and Materials and by the American Dental Association would be devised, either in present descriptive form of testing or with appropriate modification.

Durability is, itself, a significant criterion of effectiveness under the purview of FDA standards (7). The principal subcriteria of durability include maintenance of tensile characteristics, tear resistance, and non-toxicity, following normally expected exposure to autoclaving, to hygienic cleansing with sodium hypochlorite, absorption of lipid triglycerides, and exposure to ultra-violet light. The current standard PDM siloxane made from elastomer and oligomer is listed in Table 2 with all ingredients (including the pigments for a 6-member selection panel of variable yellow-red ratios).

Tensile Characteristics—Changes from Exposure Tests

Table 3 summarizes the changes (expressed in percent) from the

TABLE 1.—*Provisional Exposure Conditions for Assessing Prosthesis Durability in Long-Term, Repeated Usage*

Exposure[a]	Temperature °C	Time
Autoclaving (clinical practice)	110–125	15–30 Min
Hypochlorite disinfecting (home routine)[b]	23–25	16 Hr
Triglyceride absorption (corn oil)[c]	60–65	48 Hr
Ultra-violet	23–25	15–30 Days

[a] These conditions have yet to be finalized consistent with expected usage for several years. Test conditions may be intensified in order to compress the time scale from reality to test expediency.

[b] U. S. P. 5 percent sodium hypochlorite solution.

[c] Cooking grade of Mazola, a readily available, inexpensive medium less likely to contain oncogenic adventitiae.

TABLE 2.—*Complete Ingredient Composition of Internally Pigmented PDM Selection Panel of Six Shades*

Ingredient	Yellow dominance			Red dominance		
	SY-1	SY-2	SY-3	SR-3	SR-2	SR-1
Polysiloxane[a]	78.4	78.8	79.0	79.0	78.8	78.4
Oligomer[b]	19.6	19.7	19.8	19.8	19.7	19.6
Catalyst[c]	0.98	0.99	0.99	0.99	0.99	0.98
Pigment Conc'te.	0.98	0.493	0.247	0.247	0.493	0.297
Polysiloxane	0.473	0.237	0.119	0.124	0.248	0.493
Oligomer	0.315	0.159	0.080	0.083	0.163	0.328
Red flock	0.099	0.050	0.025	0.026	0.052	0.102
Yellow oxide	0.015	0.008	0.004	0.004	0.008	0.015
Titania	0.079	0.039	0.020	0.010	0.021	0.041
Corresponding tristimulus color indices by Hunter Lab measurements						
Reflectance	67.9	69.5	74.7	79.2	75.2	70.3
Transmission	32.1	30.5	25.3	20.8	24.8	29.7
Redness("a")	9.0	7.5	3.8	0.7	3.8	11.2
Yellowness ("b")	18.7	19.7	18.1	7.9	10.6	12.8
"b"/"a" Ratio	2.08	2.6	4.76	11.29	2.79	1.14

[a] Silicone gum Stock GE 4524 U. See Reference (1).

[b] Dow Corning DC 200 serving as oligomer. See Reference (1)

[c] Polymerization catalyst, 2,4-dichlorobenzoyl peroxide.

non-exposed controls for competitive room-temperature-cured (RTV type) silicone elastomers using tin catalysts, and for the milled PDM siloxane using peroxide catalysts and thermally polymerized in dental-stone molds. Included also are the competitive polyvinyl chloride plastisol (3) and polyurethanes (4). Except for PDM siloxane, the remaining competitive materials showed evidence of deterioration or change in the tensile modulus. All the silicones showed resistance to autoclaving and to hypochlorite sanitizing, but on exposure

TABLE 3.—*Effect of Provisional Exposure Test Conditions on Initial Tensile Modulus of Prostheses Materials*

Prosthesis Material	Exposure Test	Modulus lb/sq in	Percent change[a]
Polyisoprene (natural rubber) (Source: surgical grade)	None (control)	590	–
	Autoclaving	620	+ 5
	Hypochlorite	610	+ 3
	Triglyceride (corn oil)	420	−29
RTV Silicone (Silastic 382)	None (control)	290	–
	Autoclaving	315	+ 9
	Hypochlorite	290	0
	Triglyceride (corn oil)	260 sw	−10
RTV Silicone (MDX 4 4210)	None (control)	155	–
	Autoclaving	170	+ 9
	Hypochlorite	165	+ 6
	Triglyceride (corn oil)	100 sw	−35
RTV Silicone (MDX 4 4210) with DC Fluid (80/20)	None (control)	65	–
	Autoclaving	65	0
	Hypochlorite	65	0
	Triglyceride (corn oil)	40 sw	−38
HTV Silicone (PDM Siloxane) with DC Fluid (80/20)	None (control)	65	–
	Autoclaving	65	0
	Hypochlorite	65	0
	Triglyceride (corn oil)	63	−3
Polyvinyl chloride plastisol Type III Reference (2)	None (control)	470	–
	Autoclaving	620	+32
	Hypochlorite	570	+21
	Triglyceride (corn oil)	310 sw	−31
Polyurethane (N.I.D.R. contract) Reference (13)	None (control)	450	–
	Autoclaving	620 discolored	+38
	Hypochlorite	360	−20
	Triglyceride (corn oil)	220 sw	−51
Polyurethane (proprietary) Reference (3)	None (control)	120	—
	Autoclaving	Degraded	(not testable)
	Hypochlorite	Degraded	(not testable)
	Triglyceride (corn oil)	Dissolved	(not testable)

to a nominal glyceride (Mazola corn oil) substituting for possible skin lipid exudates, the RTV silicones showed swelling and a significant lowering of the tensile modulus, amounting to marked tactile softening.

Recovery from Strain and Hysteresis Loss (Elasticity)

In the case of many elastomers and polymers made for flexibility and/or low tactile modulus or softness, when they are strained (stretched) the result can be excessive non-recoverable extensions which can be detrimental to proper fit. Recovery from reasonable strain or stretching (provisionally up to 100 percent) and the attendant hysteresis loss (such as depicted in Figure 36 for several illustrative cases) is usually ascertained and adjusted by polymer structure in the course of competent product development, especially for minimizing likely deterioration due to exposure to chemical and normal maintenance.

Table 4 summarizes these two elastic characteristics, comparing values of the initial, unexposed material against the values resulting from the exposure tests indicated in Table 1. In this series the silicone elastomers show higher recovery from straining and the lowest series of hysteresis loss, a feature in their favor compared to the other competitive elastomers.

Tear Resistance

Prosthetic devices, especially for external facial reconstruction, often depend upon thin edges in order to blend in with the adjacent facial tissues. Because such thin edges can present serious risk of tearing, tear resistance is an important characteristic. This implies not just the tear strength, but also an innate resistance to propagation of a tear once initiated. Living tissue, including human and other dermal tissue, has the unique feature of resisting the progress of tearing by the complexity of its molecular architecture (Fig. 37) with its links and hinges and with coiled and crystalline sites, undergoing myriads of reversible transitions from the extremes of unstructured to native structure. The living tissues with these complex configurations tend to resist tearing, with considerable extension or strain taking place before the rupture ensues. The variable physiological states of hydration, lipid content, etc., with dynamic hydrogen bonding, provide significant complex energy roles for resistance to imposed strain.

TABLE 3 FOOTNOTES BELOW

[a]Percent change values below 10 percent are not considered significant at this time, but may become significant with extended exposures either in temperature or in time of testing.

sw Indicates swelling of the prosthesis material, an undesirable effect with commercial elastomers leading to solvent stress cracking.

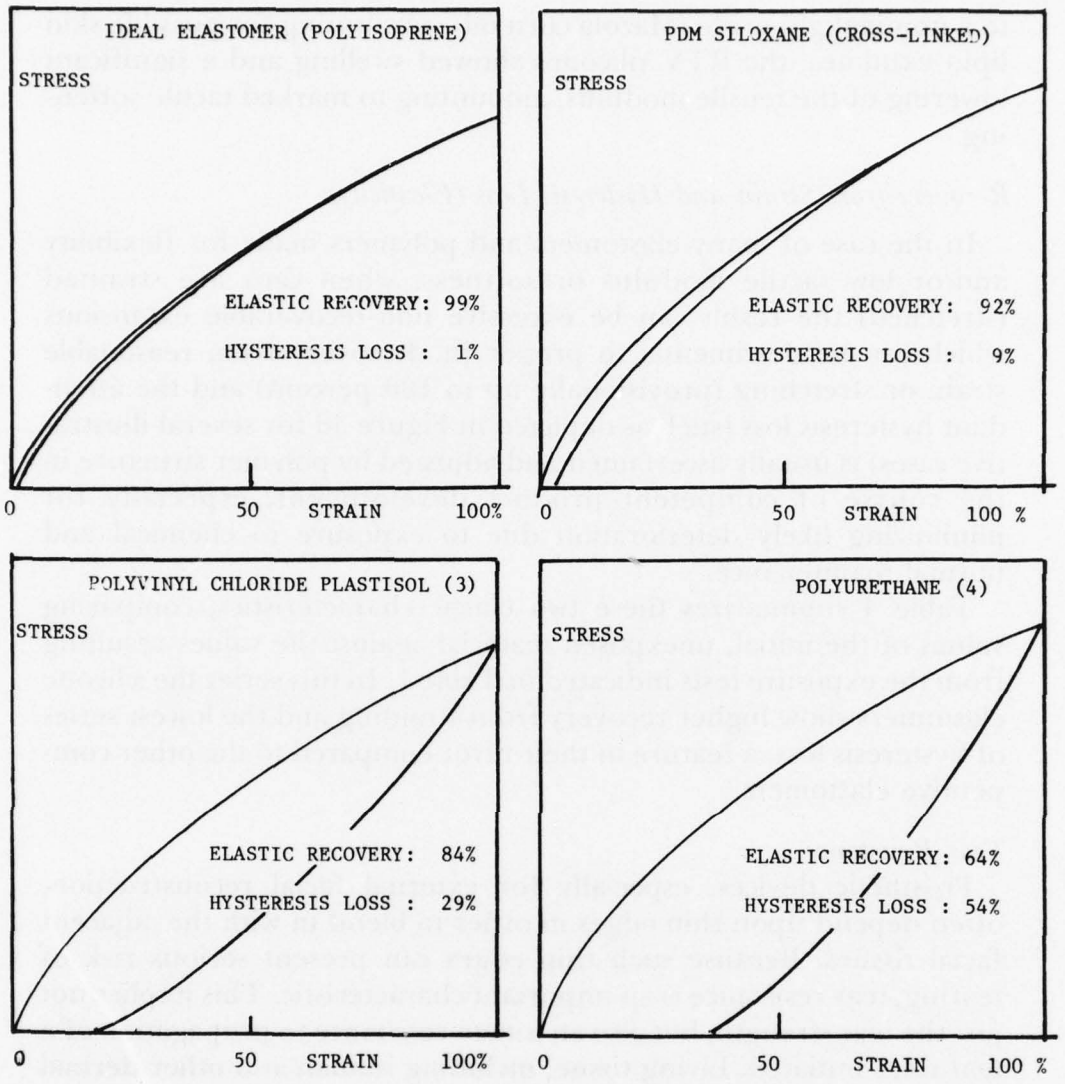


FIGURE 36.—Elasticity (stress-strain) profiles for elastic recovery and hysteresis loss with selected, competitive prosthesis elastomers.

In contrast, synthetic polymers and elastomers are characterized by simpler configurations and usually straightforward response to tearing action, unless special variations in the molecular architecture are imposed—as has been the case of the current development of PDM siloxane. The thermally (HTV), peroxide-radical-polymerized molecular configuration serves to correct for the inadequate tear resistance and sensitivity of the conventional room-temperature (RTV) tin-catalyzed silicone elastomers. Figure 38 is a model depicting the molecular architecture of these two principal forms of silicone (RTV vs HTV), serving to provide a mechanistic explanation of how to attain high tear resistance based on segmented cross-linkages between

TABLE 4.—*Comparison of Elastic Recovery of Competitive Prosthesis Materials (Non-exposed Controls)*[a]
(A.S.T.M. Test Designation D412 mod.) (100 percent strain and return)

Prosthesis Material	Percent Recovery from strain	Percent Hysteresis loss
Polyisoprene (natural rubber) (Surgical grade)	99-100	(ca 2)
RTV Silicone (Silastic 382) (Source: Dow)	96	(ca 8)
RTV Silicone (MDX 4 4210 (100/0) (Source: Dow)	94	(ca 9)
RTV Silicone (MDX 4 4210 with DC 200 Fluid (80/20)	88	24
HTV Silicone (PDM Siloxane with DC 200 Fluid (80/20))	92	(ca 7-9)
Polyvinyl chloride plastisol (Type III Reference (2))	84	29
Polyurethane (N.I.D.R. contract) Reference (13)	88	45
Polyurethane (proprietary) Reference (4)	64	57

[a]Provisional exposure tests as indicated in Table 1 are being limited to PDM siloxane, as other competitive prosthesis materials indicate hysteresis loss too-high to warrant exposure tests for elasticity.

the main silicone chains, just like the links and/or hinges depicted in Figure 37. This a priori explanation now sets the stage for the ensuing experimental verification and recounting of the test results.

Measurement of Tear Resistance

The single tear method specified by A.S.T.M. Designation D 1938 is used as the principal procedure for ascertaining the tear resistance based on the load extension chart (actually a stress-strain profile) from which the tear propagation force in grams (ounces or pounds) is ascertained using, for example, the Instron load-extensionmeter. Figure 39 depicts the tearing profiles of three competitive prosthesis materials. The first of these, RTV silicone (Silastic 382), reveals a characteristic case of autopropagation; that is, once a tear is started at the initial load level, the tearing proceeds at a considerably lessened force. Polyvinyl chloride and a proprietary polyurethane (Fig. 39c) maintain a steady tearing force to the end of the specimen. Still uniquely different (Fig. 40) is the tear profile of PDM siloxane, much like that of a physiological tissue (chicken skin) shown with it, wherein the tear for an extended elongation does not occur—instead, the response is a viscoelastic elongation to over ten times the length of the available specimen. In contrast, the RTV Silastic, and the polyvinyl

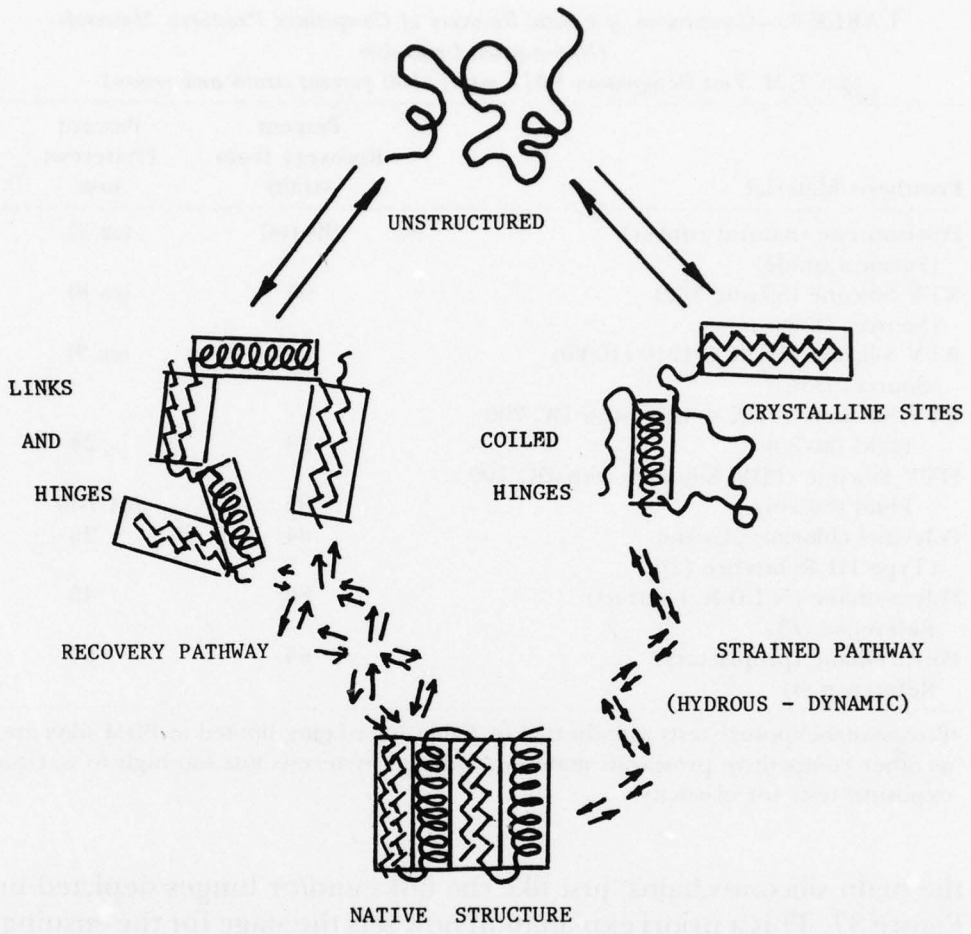


FIGURE 37.—Molecular architectural model of tissue protein configuration.

chloride plastisol, and the proprietary polyurethane, all show irrevocable tearing from as little as 50 percent elongation. The PDM siloxane does not show any tearing up to the extension of 1000 percent, which is the extension at the ultimate stress to failure.

Utilizing the various exposure conditions listed in Table 1, the tear propagation force (in grams) for a series of competitive prosthesis materials is summarized in Table 5. Of the series, both the RTV and HTV silicones maintained the tear resistance following autoclaving and following hypochlorite sanitizing, but only the milled thermally-polymerized (HTV) PDM siloxane remained unchanged in the corn oil triglyceride exposure, which apparently weakens the RTV tin catalyst links but not the HTV chain cross-links. The polyvinyl chloride plastisol and the proprietary polyurethane showed unacceptable inordinate decreases in tear propagation force in all three of the exposure tests. It can be presumed that innate chemical resistance of the siloxane repeat configuration ($O-Si(CH_3)_2-$) and the deliber-

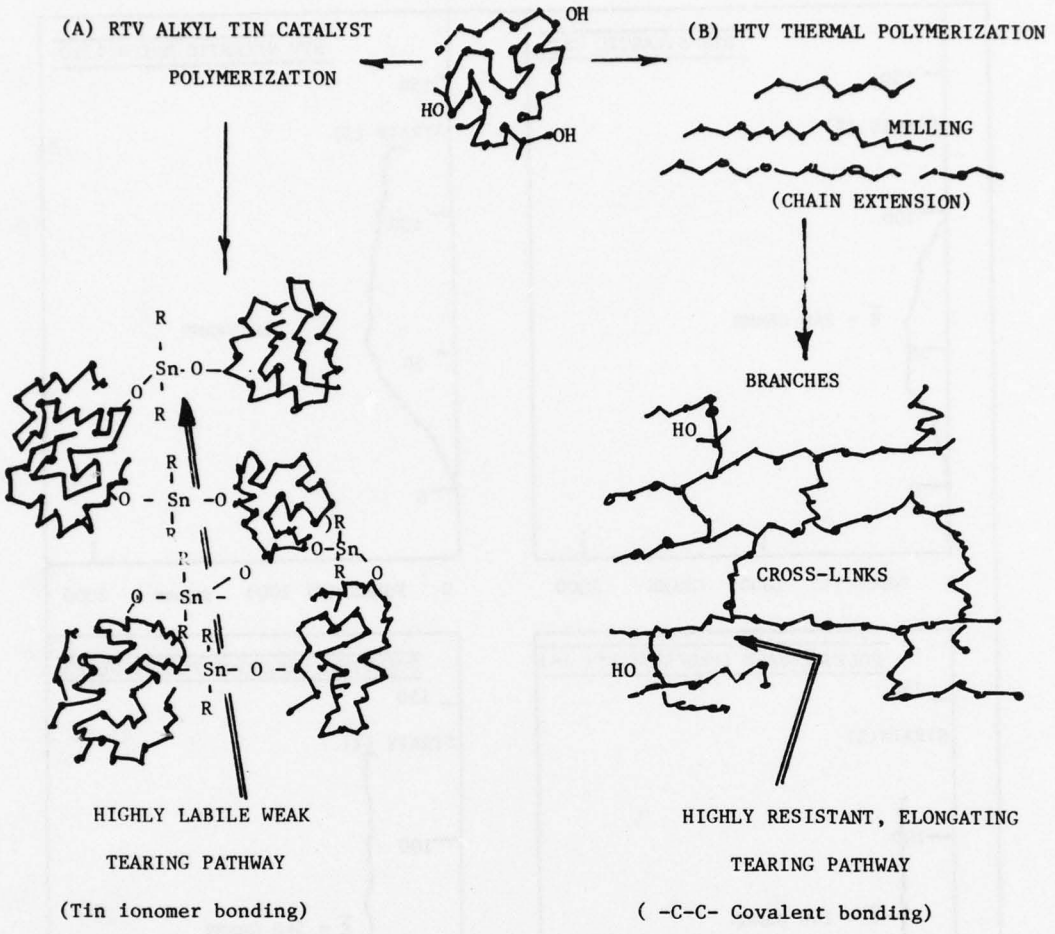


FIGURE 38.—Significance and differences in molecular structure of siloxane configuration (RTV vs HTV) on tear resistance.

ately imposed cross-linking (Fig. 38) provide the required durability for an effective prosthesis, considering the repeated sanitizing requirement. The remaining competitive materials would fail and hence would not fulfill the requirement of being effective.

The overall product development program constitutes the principal efforts aimed towards appropriate specification tests for effectiveness and especially for durability, with tests derived from realistic clinical use, including hygienic maintenance. The battery of exposure tests listed in Table 1 is applied to the provisional standard PDM siloxane composition comprising 80 parts elastomer stock (GE 4524U or its Dow equivalent) and 20 parts of oligomer with internal pigmentation to provide a range of yellow (carotene) to red (hemoglobin) ratios of coloration listed in Table 2. The 80/20 composition, and other modified ratios, will serve as the principal formulation for eventual FDA clearance for safe and effective medical devices for which toxicity tests are carried out for the comprehensive program.

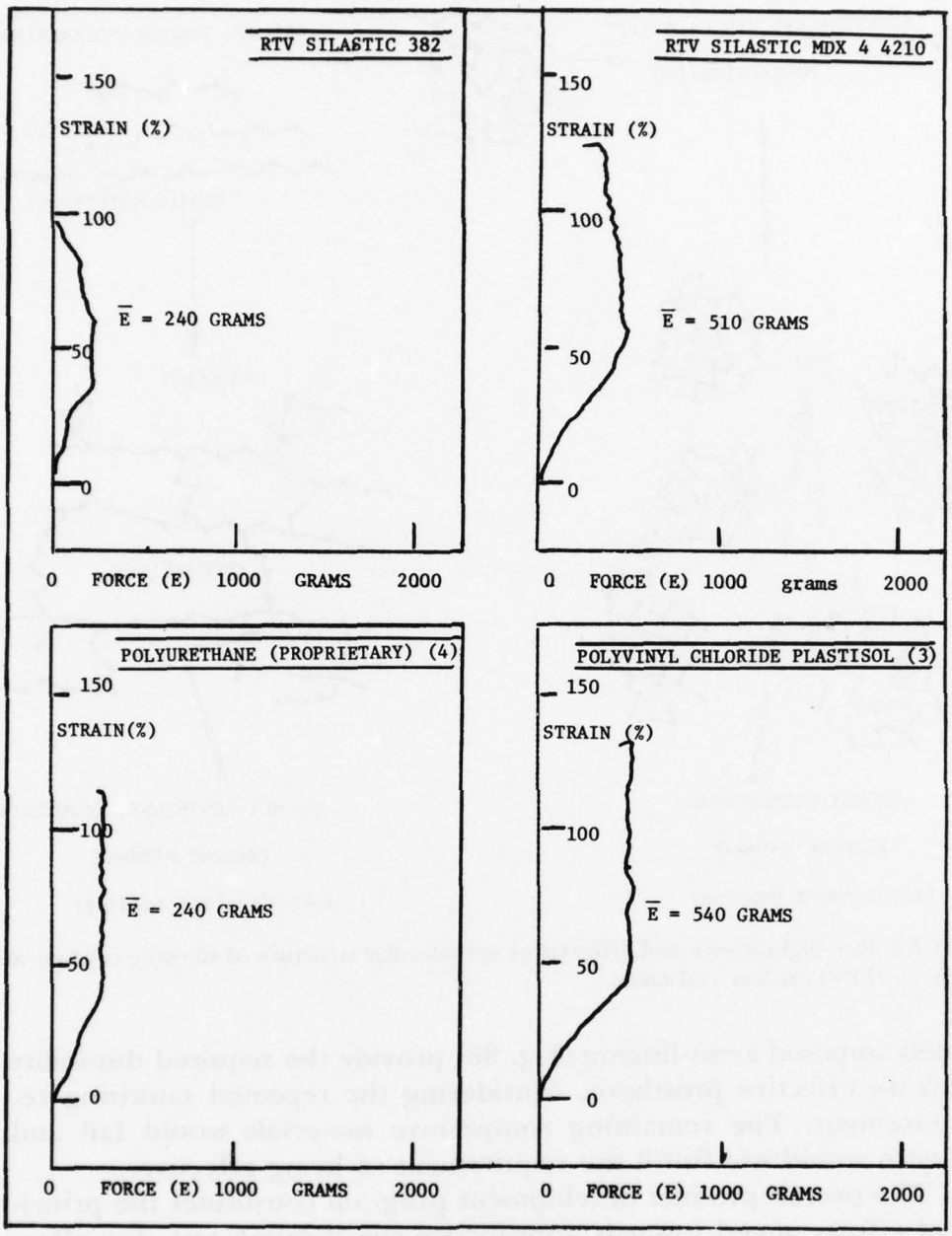


FIGURE 39.—Tear propagation resistance (A.S.T.M. D 1938) with selected competitive prosthesis elastomers.

II. Fabrication Techniques

The fabrication of maxillofacial prostheses utilizes the conventional dental stone molding (such as that commonly practiced in dental laboratories for acrylics) in the proper, effective molding of PDM siloxane elastomer stock. The provisionally standard conditions, namely 100±5 deg C for 2 hours, constituting a temperature intermediate to between the minimal temperature (80 deg C) needed for

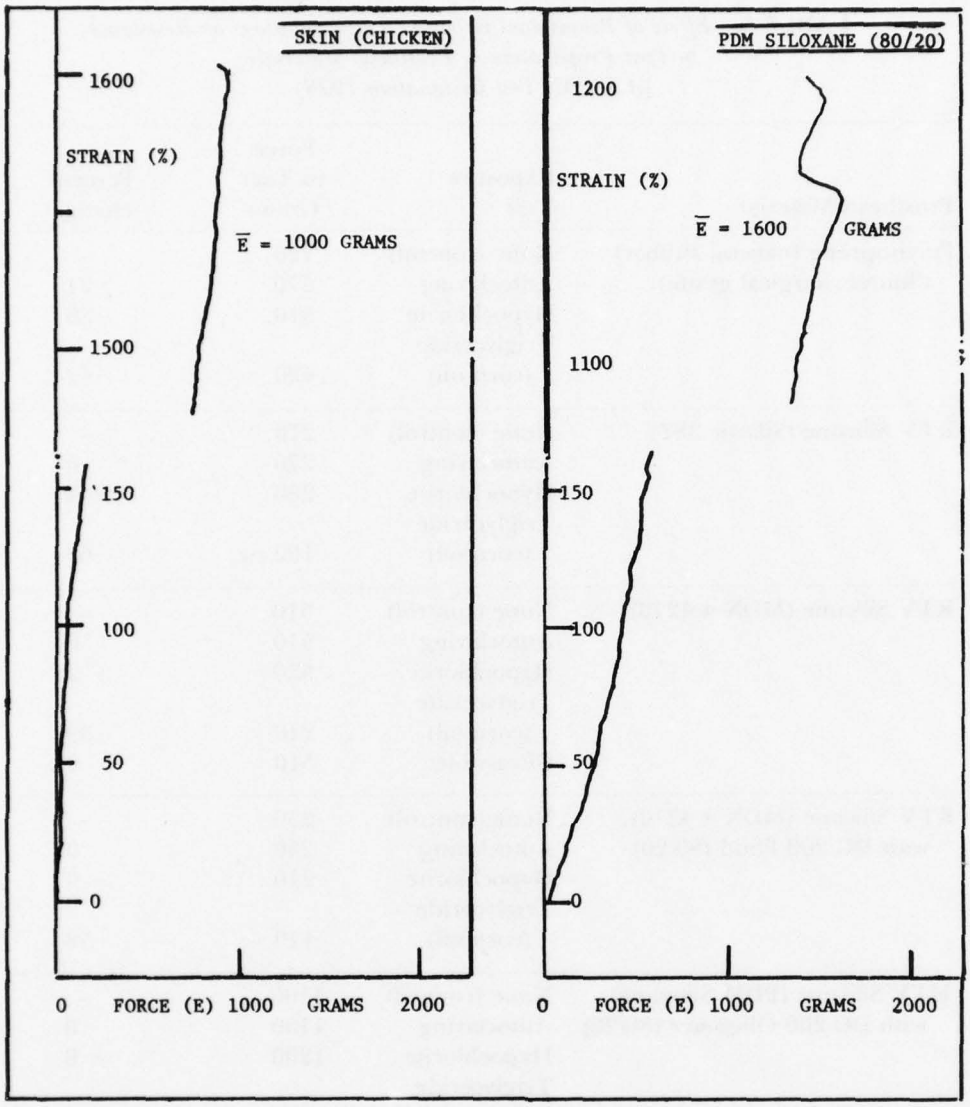


FIGURE 40.—Tear propagation resistance (A.S.T.M. D 1938) comparing PDM siloxane (80/20) elastomer with skin (chicken).

free-radical polymerization initiated by a benzoyl peroxide catalyst, and maximum temperature (120 deg C) which is not to be exceeded so as to ensure maintaining the stable hemihydrate of the stone mold for repeated molding. The provisional polymerization conditions serve to provide a balance of chain branching, along with cross-linking, for the extended (milled) polydimethyl siloxane chain.

Polymerization schedules (using thermocouples embedded into the stone mold) have been worked out for a large-capacity oven (8 simultaneous moldings) and for single-molding or small-capacity ovens for several clinics and laboratories which are participating in the field evaluation program discussed in a following section.

TABLE 5.—*Effect of Provisional Exposure Test Conditions on Resistance to Tear Propagation of Prosthesis Materials (A.S.T.M. Test Designation 1938)*

Prosthesis Material	Exposure Test	Force to Tear Grams	Percent change
Polyisoprene (natural rubber) (Source: surgical grade)	None (control)	720	–
	Autoclaving	570	−21
	Hypochlorite	510	−26
	Triglyceride (corn oil)	420	−42
RTV Silicone (Silastic 382)	None (control)	270	–
	Autoclaving	270	0
	Hypochlorite	280	+ 4
	Triglyceride (corn oil)	100 sw	−63
RTV Silicone (MDX 4 4210)	None (control)	510	–
	Autoclaving	510	0
	Hypochlorite	520	+ 2
	Triglyceride (corn oil)	210	−59
	Ultra-violet	510	0
RTV Silicone (MDX 4 4210), with DC 200 Fluid (80/20)	None (control)	230	–
	Autoclaving	230	0
	Hypochlorite	210	− 9
	Triglyceride (corn oil)	110	−52
HTV Silicone (PDM Siloxane) with DC 200 Oligomer (80/20)	None (control)	1100	–
	Autoclaving	1100	0
	Hypochlorite	1200	+ 9
	Triglyceride (corn oil)	980	− 9
	Ultra-violet	1200	+ 9
Polyvinyl chloride plastisol (Type III Reference (2))	None (control)	540	–
	Autoclaving	380	−30
	Hypochlorite	460	−15
	Triglyceride (corn oil)	280	−48
	Ultra-violet	520	− 4
Polyurethane (N.I.D.R. contract) Reference (13)	None (control)	580	–
	Autoclaving	380	−34
	Hypochlorite	470	−19
	Triglyceride (corn oil)	220 sw	−62
	Ultra-violet	430	−26

Polyurethane (proprietary) Reference (3)	None	240	–
	Autoclaving	degraded to gum	−100
	Hypochlorite	100	− 58
	Triglyceride (corn oil)	dissolving	−100
	Ultra-violet	became gum	−100

Note: Percent change values below 10 percent are not considered significant statistically, but may become significant with extended exposure either in increased temperature or in time of exposure testing.

sw Indicates swelling of the prosthesis material, an undersirable effect with commercial elastomers leading to solvent stress cracking.

During the period of this report, 216 orofacial prostheses have been fabricated for the intramural clinical program of this project and for a number of interested outside clinics. Since the inception of the maxillofacial program using the tear-resistant form of polydimethyl siloxane, over a thousand (1154) diverse orofacial prosthetic devices have been fabricated. This includes not only the prostheses for clinical support but also demonstration prostheses for assistance at outside clinics. These clinics have expressed a need to replace either polyvinyl chloride or polyurethane for one or more reasons, usually because of dependence on expensive metal molds and (not the least) because of inadequate chemical resistance, tear resistance, and biological compatibility.

III Pigmentation and Cosmetic Matching

As an important feature of standardization, a tentative 6-member internally pigmented panel of stock 80/20 elastomer/oligomer compositions is being produced in one-pound quantities. This internally pigmented panel provides a range of coloration from a dominant yellow (carotene) shade (SY) to a dominant red (hemoglobin) shade (SR) listed in Table 2 with the Hunter Digital Color Difference spectrometer values.

The six-member panel of internally pigmented stock is expected to take care of a substantial proportion of the diverse racial internal coloration. Over the basic structure, the prosthesis specialist can apply the additional coloration including melanoid spots, freckles, arterioles, etc., by external cosmetic matching to the individual subject. The tentative six-member panel of production stocks utilizes nontoxic, noncarcinogenic pigments, notably yellow iron oxide for the internal carotene, and red rayon flock for the internal arteriole coloration.

IV. Toxicity Testing

This phase of the Comprehensive Development Plan ranks high

among the over-all priorities of the project. It is aimed at demonstrating that the PDM siloxane is safe to human tissues, as is required under the current FDA regulatory provisions (10). As indicated in a previous report (BPR Spring 1978, 145–151), a novel approach of direct relevance to individual human subjects has been adopted by using a broad range of human excised donor (HED) tissues. The approach also tends to demonstrate that no growth inhibitive, or morphological, effect is evident when a test section of a fabricated PDM siloxane prosthesis is imposed during the tissue culturing.

The collection of HED orofacial tissue reported previously (gingival and nasal mucosa) has been expanded to include other orofacial tissues, especially from the soft palate, trachea, larynx and esophagus, which are involved in head and neck cancer surgery cases which also require prosthetic devices—for which the PDM siloxane is eminently suited. Table 6 summarizes a number of a variety of orofacial tissues tested with samples from one-pound production lots of the internally pigmented panel stocks of PDM siloxane. This type of data is being accumulated in order to provide qualifying data for pre-market approval, which will have to be applied for under the current FDA provisions, with demonstrated application of good manufacturing practices. This project is aimed toward providing these requirements with detailed operative procedures, from starting materials to finished prostheses which have had actual exposure to sanitizing treatments.

The favorable HED tissue toxicity testing results on PDM siloxane, as disclosed in a previous report (2) and in several presentations, has stimulated interest for such uses of PDM siloxane for ophthalmic and orbital membranes and as an artificial dura mater for which appro-

TABLE 6.—*Accumulation of HED Orofacial Tissues Showing No Toxic Response with PDM Siloxane Prostheses*
(See Reference (2)—Figure 12, Biometric Data Base)

HED Tissue type	Total to date	Age range	Radiation cases[a]
Skin	3	9-48	0
Lip	2	50-56	1
Nasal mucosa	8	20-54	1
Gingiva	12	19-60	0
Soft palate	1	54	0
Pharyngeal	2	57-60	1
Laryngeal	1	29	0

[a]The cases which have received radiation in the course of cancer therapy are of particular concern, as the contact of mucosal tissues is suspect of initiating or potentiating carcinogenicity in remote vital organs as shown by Hueper (6) in experimental animal tests. A significant proportion of maxillofacial reconstructions are for patients who have been given serial radiation therapy.

priate tissue culture testing is planned in order to test for biocompatibility.

Currently, a major portion of the HED tissue culture toxicity testing is now being directed toward surveillance of chromosomal characteristics, to further augment the validity of the visual morphological assessment. This program will involve, in due course, progressive tracing of the chromosomal characteristics influenced by prolonged tissue growth in direct contact with PDM siloxane surface beyond the current 3-to-14-day test duration. The effort is also intended to include a novel technique for ascertaining oncogenicity during HED tissue testing by the sister chromatid exchange technique (11), which may replace the Ames Salmonella/microsome mutagenicity test (12). The chromosomal assessment in both these programs can serve most constructively in providing proof of safety to human tissue and consequent cytogenetics, especially for long-term insertive and implantation PDM siloxane artifacts and medical devices.

V Field (End Use) Evaluation of Fabricated Prostheses

The exceptional quality of the PDM siloxane in regard to chemical resistance and high tear resistance, coupled with simple, inexpensive moldability in dental stone molds, continues to attract participation in end-use evaluation from nearly a score of outside maxillofacial prosthetic services, including participants in Holland and Norway. The field evaluation participating program (Fig. 41) is aimed toward gradual replacement of polyvinyl chloride and polyurethane prostheses. Despite their shortcomings, these are tolerated, but only because there is no manufacturing source for the milled, internally pigmented PDM siloxane stock. As far as the needs for the Veterans Administration are concerned, the on-coming production in the current project can accomodate all VA needs.

For the participants, the program provides a complete stock of the internally pigmented six-membered panel in 1-lb lots, a complete set of pigments for external cosmetic matching, and a set of directions for molding in dental stone mold and for cosmetic matching. In return, the participants return at least one molding from each one of the 6-member panel for inspection of the formed prosthesis. Reports on their quality and suggestions on prosthesis design are proferred to the participants. This program had been informally initiated in early 1978, after the HED toxicity tests showed no toxicity for PDM siloxane prostheses. For the VA involvement in prosthetics, this participative program was formally proferred at the conference of orthotic laboratories and prosthetic activities, sponsored by the VA Rehabilitation Engineering Education Program (REEP), September 18-20, 1978, at Palo Alto, California, with actual fabrication demonstration. A training conference is being planned for maxillofacial prosthetic specialists

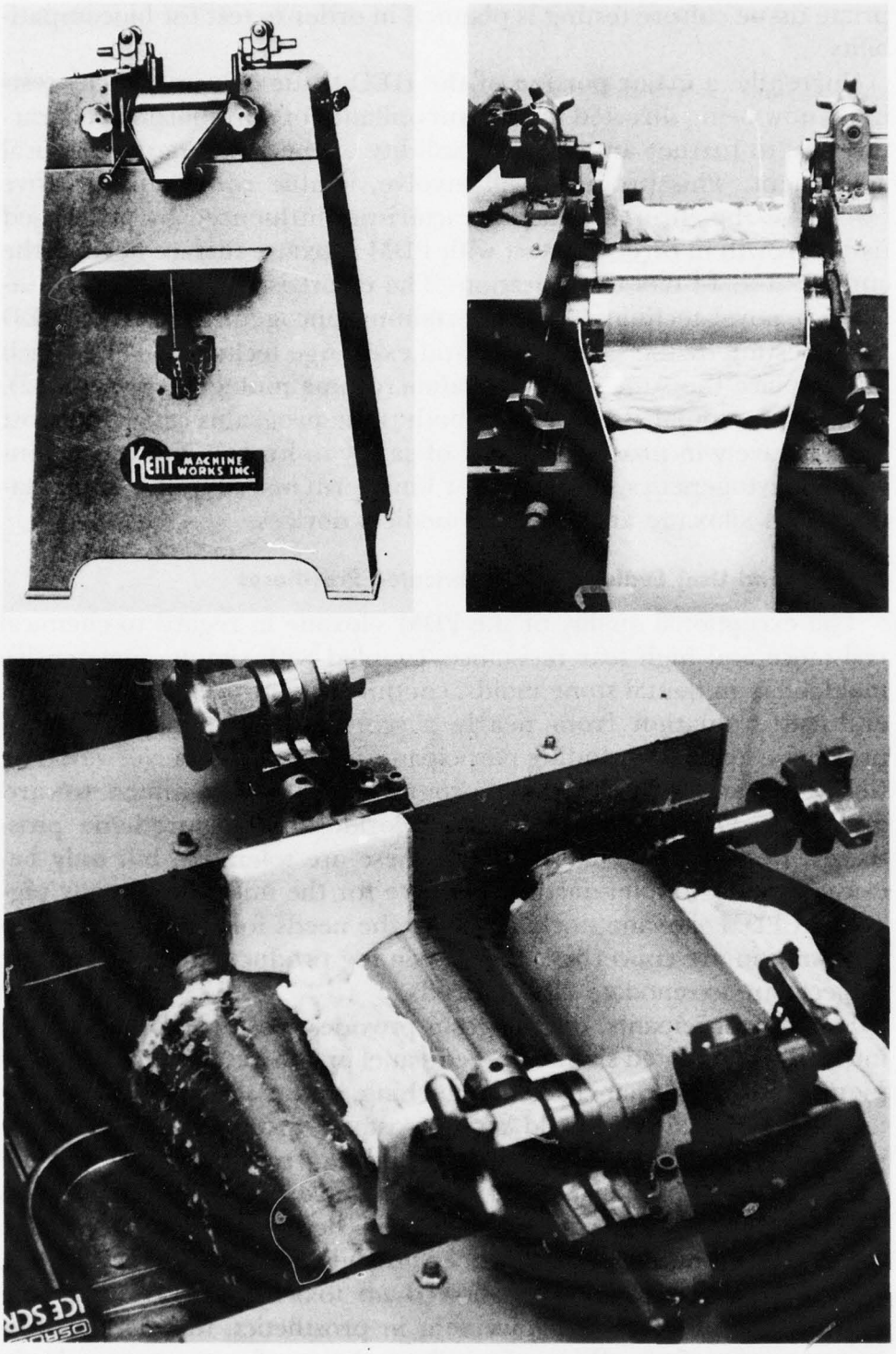


FIGURE 41.—From production to field evaluation, including VA-wide availability of PDM siloxane for orofacial reconstructions: a. three-roll, high speed mill for production of PDM siloxane stocks, b. side view of milling and blending with discharge end, c. top view of milling and blending of prepolymer, oligomer and pigments. After packaging, the PDM siloxane is sent out for field (end-use) evaluation.

and clinicians this April-May under the sponsorship of the VA Northeast Regional Medical Education Center (REMEC). This conference will include actual molding and cosmetic matching of PDM siloxane and will provide all necessary materials.

VI Production

During the period of this report, three production campaigns for a total of 34 one-pound lots of PDM siloxane (80/20) were made at the plant of Charles Ross and Son, Hauppauge, Long Island, New York, manufacturer of the three-roll mill capable of blending the 80/20 elastomer/oligomer stock with the added pigments, at a production rate of up to 24 one-pound lots per 8-hour operating day. Each one-pound lot provides for 20 to 25 average maxillofacial prostheses. No firm figures on the VA needs are at hand; an assumed need for 1000 single reconstructions annually (an average of 50 prostheses each for 20 likely centers) would amount to barely 20 to 25 kg (44 to 50 lb) or just about 2 days of operation. Therefore, the production facilities of this project can readily accomodate a possible nationwide estimate of 5000 reconstructions annually. For the latter reason the field (end-use) evaluation program, by providing specification grade PDM siloxane, is an appropriate means for stabilizing and standardizing a safe and effective biomaterial for extensive orofacial reconstructions, and in due course shifting from dependence on current expedient proprietary prosthesis materials of unproven safety and effectiveness in terms of standard end-use tests.

Acknowledgment

The participation of Dr. Irene Mildan on the preparation and exacting maintenance of the tissue culture technique and standardization for the HED tissue toxicity system is gratefully acknowledged, as is the invaluable assistance and guidance by Dr. Mary D. Nadijcka for expertise in cell development and genetic implications. Not the least is the acknowledgment of the interest and cooperative assistance of Dr. W. Hayman Behringer, Chief, E.N.T. Section, and Dr. James S. Reilly, E.N.T. Section, Veterans Administration Medical Center, Wilmington, Delaware, who are providing the orofacial tissues for the HED toxicity testing system.

References

1. Lontz, John F. and James W. Schweiger: Maxillofacial Restorative Biomaterials and Techniques. Bull. Prosth. Res., BPR 10-28:182-188; Fall 1977, see especially p. 182.
2. Lontz, John F. and James W. Schweiger: Maxillofacial Restorative Biomaterials and Techniques. Bull. Prosth. Res., BPR 10-29:145-155; Spring 1978, see especially pp. 147-153.

3. Sweeny, W.T. et al.: Evaluation of Improved Maxillofacial Prosthetic Materials, J. Prosth. Dent., 27:297-305 (1972).
4. Gonzalez, Juan B.: Polyurethane Elastomers for Facial Prosthetics. J. Prosth. Dent., 39:179-187, 1978. (The disclosure on the use of organic tin catalysts therein is not in conformity with the findings on toxicity in Reference (5).)
5. Guess, Wallace L. and Sue Haberman: Toxicity Profiles of Vinyl and Polyolefinic Plastics and Their Additives. J. Biomed. Mat. Res., 2:213-335, 1968.
6. Hueper, W.C.: Experimental Production of Cancer by Means of Implanted Polyurethane. Amer. J. Clin. Path., 34:334-337, 1960. This article discloses the carcinogenicity of several physical forms of polyurethane plastic emerging remotely from the implant sites (subcutaneously in the neck area, and intraperitoneally), of female rats in such vital areas as the liver, lymph nodes, and uterus. This finding has been and is widely known among those in the polymer industry, yet certain proprietary ventures continue to proffer polyurethane for prosthetic devices and for adhesives, ignoring the published warning by Hueper.
7. Horton, Linda: Medical Devices. Strengthening Consumer Protection. FDA Consumer, Oct. 1976, HEW Publication No. (FDA) 77-4005.
8. Lontz, John F. and James W. Schweiger: Maxillofacial Restorative Materials and Techniques. Bull. Prosth. Res., BPR 10-24:241-243; Fall 1875.
9. Lontz, John F. and James W. Schweiger: Maxillofacial Restorative Materials and Techniques. Bull. Prosth. Res., BPR 10-27:161-165; Spring 1977.
10. Federal Register, Department of Health, Education and Welfare, FDA, Medical Devices, Procedure for Investigational Device Exemptions, Part III, May 12, 1978.
11. Wolff, Sheldon and Paul Perry: Differential Giemsa Staining of Sister Chromatids and the Study of Sister Chromatid Exchanges without Autoradiography. Chromosoma (Berl.) 48:341-353, 1974; also Perry, Paul and Sheldon Wolff, New Giemsa Method for Differential Staining of Sister Chromatids. Nature, 251:156-158, Sept. 13, 1974.
12. Ames, Bruce N., Joyce McCann and Edith Yamasaki: Methods for Detecting Carcinogens and Mutagens with Salmonella/Microsome Mutagenicity Test. Mutations Res., 31:347-364, 1975.
13. Robeson, Lloyd M., Winfred J. Saunders, Sui-Wu Chow, and Markus Matzner: Development of Improved Materials for Extraoral Maxillofacial Prosthesis. Contract No. N01-DE-42436. Comprehensive Final Technical Report, June 1, 1974 to November 30, 1976. National Institute of Dental Research, National Institutes of Health.

Permanently Attached Artificial Limbs
Southwest Research Institute
8500 Culebra Road
San Antonio, Texas 78284
C. William Hall, M.D. and William H. Mallow

Development of Adhesive Systems for Prosthetic Implant Coatings[a]

Implant materials that traverse the skin must have a compatible surface for developing a skin interface that will promote healing and

[a]The work reported here has been primarily conducted by William H. Mallow and is a summary of ongoing research in this area. (Mr. Mallow has also written an 8-page "Overview of Adhesive Bonding" which discusses the molecular characteristics of adhesives and explains, in non-mathematical terms, requirements for lasting mechanical bonds. If you would like a free copy, write to BPR's Editor.)

prevent microbial invasion. One such example has been the requirement for a percutaneous load-bearing skeletal extension (PLSE). For load-bearing qualities, stainless steel meets the requirements, but it is not suitable for interfacing with the skin and subcutaneous tissues. Bonding a suitable skin interfacing material to the stainless steel element requires the use of an adhesive. Most adhesives eventually degrade when placed in the hostile environment of living tissues. The problems encountered with adhesives used under these conditions are discussed.

Adhesive Bonding

Adhesive technology encompasses the parameters of the combined fields of rheology, surface energetics, surface chemistry, surface tension, solid and liquid kinetics, colloid chemistry, physics, mechanics, thermodynamics, electrochemistry, electrostatics, and various principles of polymer science. When biological systems are involved and the bonding involves the environment of living organisms, adhesive science acquires a more complex set of parameters. Every physiological, microbial, pathological and biochemical function inherent in living organisms adds to the hostilities and resulting stresses imposed upon the adhesive system. Numerous papers and texts have been devoted to the basic and applied science of adhesion and provide the background of the study represented in this report (1,2,3,4,5).

An analysis of the criteria for designing a prosthetic implant device has been previously published, and these criteria were used by the engineers for selecting materials to meet the physical, mechanical, chemical, and biochemical requirements (6,7). The design of the mechanical device, the selection of interfacing materials and adhesives, and the final construction of the prototype were developed jointly by the engineers, chemists, and surgeons. The major contributions of the chemists to this effort were the selection and application of polymers and coatings and the adhesive bonding of these components to the prosthetic hardware.

Criteria for Selection and Testing of Adhesives Systems for Prosthetic Coatings

A survey of various adhesives, surface treatments, and primers was conducted, with special emphasis on the criteria of biological and physiological compatibility with the candidate adhesive system. The development and survival of the adhesive bond in vivo provided the basis for final selection. This limited the candidates to the families of silicones, expoxies, and acrylic adhesive systems, which are well known in the biological and physiological domain.

The single most contributory factor in the loss or destruction of the adhesive bond between an organic surfacing material and a metallic

substrate, or between any surface and substrate material to be used in biological implants, was identified as an attack by water or water vapor. Second in importance was the attack of electrolyte solutions and water vapor in a synergistic phenomenon, followed by the vulnerability to attack by microorganisms or enzymes within the host animal. Conventional silicone adhesives (primed or otherwise); many of the commercially available epoxies, polyesters, acrylics, and elastomeric cements; and cyanoacrylate adhesive systems were ineffective when subjected to humid aging, autoclaving, and boiling-water tests. Humid aging was the most severe and aggressive environment toward adhesive/adherend integrity and approximated in vivo factors in an accelerated mode of testing.

Three standards of quality acceptance were selected to assure a stable bond in the animal implant material studies:

1. humid aging resistance to 180 deg F for 2 wk at 100 percent relative humidity;
2. resistance to 250 deg F/100 percent relative humidity autoclaving for 4 hr; and
3. biological and physiological compatibility for application in animal studies.

Of the many materials tested, only one met all three of these quality standards.

A two-component epoxy adhesive manufactured by Thermal-Chem of Elk Village, Illinois, designated "14R"®, was the most effective in laboratory screening and ultimately in the in vivo studies. This adhesive comprised a polyamide-cured epoxy of a specific composition proprietary to the manufacturer which, unlike many other epoxies evaluated, was not weakened, debonded, or otherwise deteriorated by exposure to steam, autoclaving conditions, or boiling water. The substrate upon which this adhesive was applied was prepared by either sandblasting or knurling to provide a greater surface area to optimize both intimate contact and good integration of the adhesive, adherend, and the coating. The surface was then scrupulously cleaned, first with water and detergent and then rinsed with deionized water, acetone, and chlorinated solvent. Finally, the assembly was baked until dry. Exposure to autoclave conditions for 30 min effected the desired sterilization and identified a poorly bonded assembly if such existed.

Many authors suggest that desorption of the adhesive by water occurs at the adherend surface, with all the available bonding sites becoming occupied by water. Probably the most conclusive work illustrating bond desorption by water is in the field of resin/glass laminates (8,9,10,11). Desorption by water can occur by either of two methods:

1. The adhesive can absorb the water, whereupon the water permeates the adhesive at the interface where desorption takes place.

2. The water may diffuse along the adhesive/adherend interface.

Laird (12) has shown that diffusion of water along the glass/resin interface of an epoxy-bonded E glass takes place 450 times faster than permeation through the resin. Workers in the field are beginning to admit the possibility of adhesive displacement by water, yet maintaining the improbability of bond failure in adhesion. Other evidence supporting the desorption theory is the heat of immersion data by Harkins (14) and co-workers who show that water develops a greater work of adhesion for polar solids such as titania and silica than do liquids such as propanol, acetone, and benzene (13,14,15). The work of adhesion of water for polar solids is greater by a factor of three or more than for any other liquid evaluated. More recent work by Eley and Radham (16) makes the same point clearer with more polar liquids and with epoxies as well. Heat of immersion shows that water is adsorbed both physically and chemically, depending upon the temperatures at which the substrate is degassed. Liquids such as hexane are adsorbed physically and with relatively low heats of immersion. When adsorption studies are made with combinations of liquids, the desorbing effect of water is the dominant factor. As little as 0.02 percent of water and benzene will give almost the same heat of immersion for polar solids as for pure water. Hackerman (17) and others have shown more recently that water displaces hydrocarbons from aluminum oxide surfaces both rapidly and quantitatively.

When one considers that water develops a greater work of adhesion on polar solids than any of the liquids or polymers evaluated heretofore, the implications in terms of desorption capability of water for adhesives in biological systems cannot be overemphasized. White (18) indicated that once a liquid other than water is adsorbed onto the solid, it can be preferentially desorbed by water or by any liquid that develops a greater work of adhesion to that particular solid. The phenomena of adsorption and preferential displacement are widely applied in gas and liquid chromatography and are not restricted to low-molecular-weight materials. Separation of polymers with molecular weights as high as 2 million is described in this technology.

An important factor in designing a stable bond to metal surfaces is the match of the mechanical properties of the adhesive to the substrate. Stresses induced by mismatches in the modulus of elasticity and in thermal expansivity have resulted in bond failure, especially when the device experienced mechanical stresses induced by a mismatch of the physical properties. Major differences in densities between the substrate and the adhesive result in shock wave reflections at the interface, producing discontinuity.

Interface imperfection in the form of trapped air bubbles creates sites for localized stress concentrations that augment interface desorbing agents. Where differences in the coefficient of expansion are

large, use of an adhesive such as nitro-rubber phenolic, which can relieve stresses because of its very low modulus, is ideal, both as a strong fastener and as a stress relief interlayer. The extent of the bonding action is determined almost entirely by the initial wetting and spreading and adsorbing action of the adhesive. Once this has achieved equilibrium with the adherend, the subsequent hardening action of the adhesive, whether by solvent evaporation, cooling, or chemical polymerization, can only detract from adhesion by introducing stresses within the bond area.

Critics of this reasoning will immediately point out that strength of the bond at the assembly increases with time as the drying, cooling, and polymerization process continues; however, this merely reflects the increase in strength of the adhesive material and has no significance in terms of attraction forces at the interfaces. These introduced stresses include those caused by shrinkage and differences in coefficient of thermal expansion, representing the primary factors responsible for bond failure in adhesion.

Stresses at any bond interface can also be created by swelling during the solvent adsorption. The adhesive, being normally organic or semiorganic in nature, and very polar, can be sensitive to aqueous and organic environment. Any adsorption may result in swelling, and the adherend, especially if it is metallic or ceramic, will not swell. The point of discontinuity will be the plane of greatest stress concentration. If stress concentrations are accompanied by aqueous desorption of a physically adsorbed adhesive, failure in adhesion is inevitable, and finally, corrosion of the adherend or the substrate, caused by the adhesive or by the environment, is a possibility that must be considered. In selecting the metal or the material for the substrate, its compatibility with the host environment, as well as with the adhesive, must be seriously considered. It is not always possible to predict corrosion versus adhesive/adherend combinations by short-term exposure tests as recommended by ASTM. Hence, the corrosion must be considered as a possibility, even in well prepared bonds. However, it can be argued that corrosion of the substrate by the adhesive and/or the environment occurs only after the adhesive has been desorbed; thus, the corrosion takes place at the vacated active sites.

Pursuant to this theory, in preparing our velour coatings, the substrate was carefully cleaned, freed of any corrosive materials, and the adhesive applied as thoroughly and continuously as possible to preclude trapping of air, moisture or other agents conductive to localized corrosion. In addition, the bond was effected as continuously as possible from extremity to extremity to again preclude infusion of corrosive agents, air, and moisture between the bond and the substrate adherend.

There are few environments as hostile and severe toward im-

planted adhesives and other materials as is the living organism. A combination of moderately high temperature, high moisture, moisture gradients, electrolyte solutions, electrolyte gradients, enzymes, microbes, chemicals of infinite variety, electrochemical and physical chemical reactions, and endless hosts of physical and biological parameters constantly attack implanted materials.

Materials selected for use as coatings between mechanical implants and tissue fall in the general classification of biomaterials. When an implant material is recognized as foreign, the host tissue either digests the foreign material, isolates it with a fibrous membrane, or eliminates it from the body. If the implant material is ignored, it is probably not identified by the host as foreign material.

Adhesive strength between implant material and surrounding tissue may be measured by using a torque meter. Tissue culture techniques in vitro can be used to determine cell adhesion ability by measuring contact angles of the cells adhering to the surface of the material. When a plastic whose molecular structure is known to be polar or wettable is used for the tissue culture substrate, a close relationship is formed between the molecular structure of the plastic and the cell tissue. Cells exhibit a very high contact angle or very low adhesion toward polymers such as silicones, polyethylenes, and polystyrenes because of the alkyl radical or the hydrocarbon constituents that are repelling toward cell tissue, resulting in poor cell adhesion. On the other hand, acetylglucose amine and cellulose, which have many hydrophilic radicals, show a high degree of wettability and have small contact angles with the cell, resulting in strong cell adhesion. The surfaces of hydrophilic plastics and ceramics are polarized and are considered to develop hydrogen bonds or van der Waals forces between the hydrophilic surface and extracellular substances which are granular proteins and gluco-proteins. The binding energy, although strong, probably occurs in a part of the whole surface of a cell, and a structural recomposition is probably taking place constantly at the molecular level, even in the cell unit membrane. This assumption has been confirmed by electron microscopy by Kawahara, Fisher and Flaxman (19,20,21).

The greatest adhesion is achieved between cell tissue and ceramics or oxides. Most ceramics, metals, and metal oxides are very hard, brittle materials, void of any flexibility or ductility. This characteristic may be adequate in an implant in which all components are static and fixed, requiring no mobility, vibration or translational energy about the implant, but most implants experience a considerable amount of torque, tension, compression, and other types of loading. Implants exposed to or borne by a rigid tissue-to-substrate interface usually result in a shear of the ingrowth from the implanted material. To circumvent this, many experimenters have developed flexible and

porous coating materials to interface mechanical load-bearing devices with tissue. Such materials as nylon, Dacron® velour, and Proplast® are among these. Although the adhesion to the fluorocarbon polymer materials is less than to nylon, Dacron, or the oxides of metals and minerals, the bond is much more durable and resistant to mechanical loading than the adhesive bond between metal oxides or mineral oxides with tissue.

In this program, it was expedient to concentrate on those biomaterials that combine reasonable strength, biological stability, and a measure of resilience and mobility to withstand the mechanical and dynamic forces imposed upon the interface of the prosthetic implant and the animal host. Although nylon velour is recognized to be less than ideal, the duration of the experiments with the host animal were designed to permit evaluation of the basic concept and parameters of the type of material being employed before any significant biological or physiological degradation or rejection occurred.

Materials and Methods

Through the course of this program, several materials were implemented and evaluated as mechanical substrates for biological implants. These materials included stainless steels, Vitallium, graphite-epoxy composites, and fiberglass-polyester composites. Prosthetic implant prototypes of each material were coated with one of the following candidate materials:

1. Porous acrylic plastic
2. Biocarbon material
3. Porous alumina
4. Bioglass
5. Nylon velour
6. Proplast®

The acrylic plastic consisted of a modified styrene, high-impact acrylic polymer blended with monomer in proper proportions. The monomer/polymer mixture was then blended with various quantities of ascorbic acid, granulated to a specific particle size. The slurry was cast into specially prepared metal or plastic implant substrate surfaces and allowed to cure to maximum rigidity. Subsequently, the plastic coated implant was machined to the exact proportion and configuration for surgical application. In the process of machining the surface away from the cured acrylic, the granules of ascorbic acid were exposed to the surface. By immersion in warm water, the exposed granules of ascorbic acid were extracted, dissolved and removed, leaving preselected cavities or pores of such diameter and depth ($\sim 100\ \mu$) as to facilitate ingrowth of tissue and bone. The polymer/steel or polymer/plastic interface was prepared in the following manner:

For use on stainless steel, the surface of the metal was first

sandblasted with a very fine-grit quartz powder and then rinsed with deionized water containing a small amount of anionic detergent, flushed again with deionized water, rinsed with acetone and then with methylene chloride. It was then oven-dried for a few moments before coating with the acrylic. The coatings were applied as soon after drying as was practicable, and the coating material was worked into the surface by a gentle abrading or rubbing of the polymer slurry onto the surface to assure good contact and wetting.

Both Biocarbon and Bioglass are applied under intense heat. Carbon is usually applied by a sintering process whereas Bioglass is usually applied by flame spray.

Each of the above discussed coating materials represents a class of rigid solids. In contrast to this approach, several non-rigid, fibrous and porous products have been evaluated as coatings to provide the proper interface between the mechanical and the biological entities. These materials were adhesively applied to the mechanical substrates following a similar type of preconditioning to the metal as was described for the application of the acrylic plastic. The surface of the metal was abraded by sandblasting and scrupulously cleaned and dried, followed by the application of one of the velours with the aid of an epoxy adhesive. The most effective epoxy adhesive found for this particular application was supplied by Thermal-Chem of Illinois.

To further assist in obtaining a dependable and stable bond between the velour and the metal substrate, especially in areas where the metal surface was very small, and where the loads and the stresses applied to that surface were substantially greater than in the larger surface areas, the substrate was not only sandblasted, but also a medium knurling was applied to the surface. Adhesive was lightly applied to the metal substrate and to the velour. The velour was subsequently pressed into the surface and held in place until the polymers were firmly set; then the assembly was warmed for approximately 24 hr to assure a complete cross-linking of the epoxy. The velour-coated assembly was then subjected to boiling water for 2 hr, to saturated steam in an autoclave environment for 4 hr, and to a humid aging test (180 deg F thermal blanket and 100 percent relative humidity for 7 and 14 days). Specimens exposed for 14 days did as well as those exposed for 7 days. There was no apparent indication of debonding or attack on the epoxy/substrate interface. To identify the efficiency of the bond, peel strength tests were conducted on a steel adherend, onto which strips of nylon velour were adhesively applied. Efforts to peel the velour from the metal substrate resulted in tensile failure of the velour; that is, the velour actually failed and tore internally before the adhesive bond could be broken. This test was also repeated after 2 weeks of humid aging at 180 deg F, 100 percent relative humidity, with identical results.

Proplast® was applied by its developer in Houston and consisted of a Teflon-coated synthetic material (Teflon and carbon fiber) that was applied to metal substrates by a heat and pressure process, utilizing the thermal-plastic nature of Teflon.

Conclusion

Several Proplast® and velour-coated prostheses have endured for as long as 12 mo in vivo with no adverse effects. Failures were observed in the metal substrate, resulting from unexpected loads induced by the animal or through bacterial invasion at the transition of internal/external members. These two were often mechanically initiated by accidents in the fenced area. There has been no observed biological attack or deterioration of the implanted surfaces during 6 to 12 mo implants.

Due to the design of the intramedullary portion of the skeletal device, its weakness is divulged under loads of tension. Two long term animals (up to 12 mo post implantation) had the prosthesis pull out

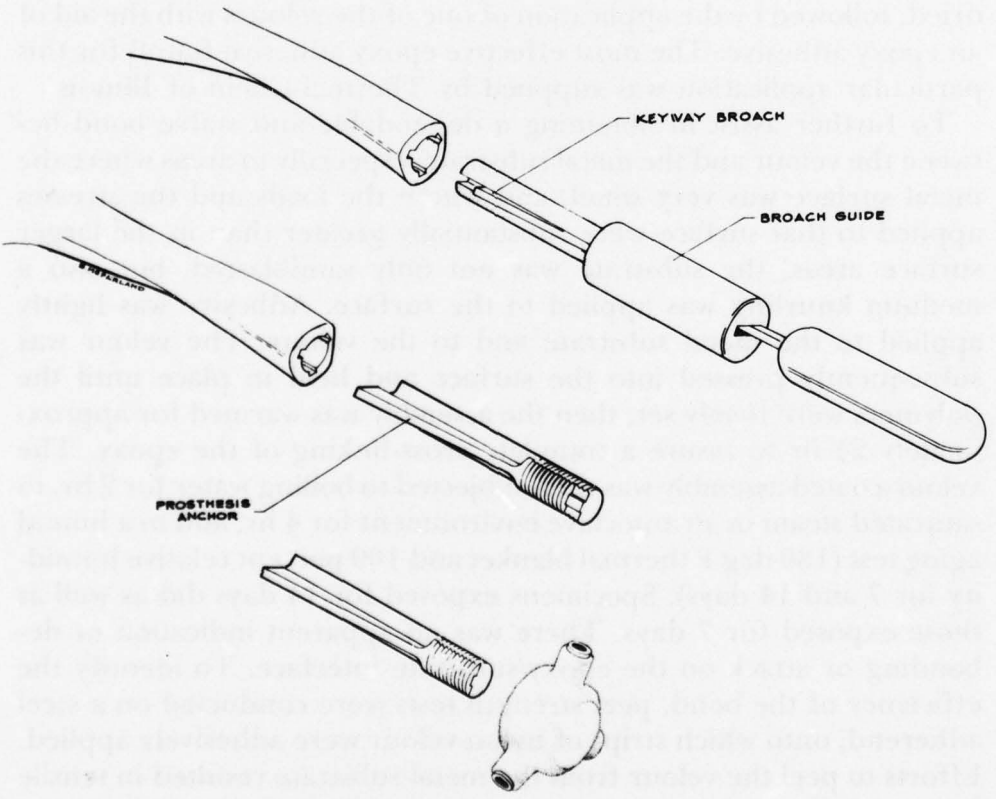


FIGURE 42.—Top drawing illustrates tool that will be used to broach a tapered slot in the cortex to receive the two-part intramedullary pin shown in the bottom two illustrations. The two-part pin allows the insertion and locking in place of a tapered keyway that will prevent pullout under tension.

after becoming entangled in a woven wire fence. A prototype has been designed and fabricated which has the proximal portion of the intramedullary portion wider than the distal shank, making pullout under tension impossible without fracturing the cortex (Fig. 42).

Failure of the adhesion of the Proplast® has not been observed. An occasional failure of the velour bond has occurred on that portion of the lug which is exterior.

References

1. Skeist, I.: Handbook of Adhesives. Reinholdt, 1962.
2. Cagle, C.V.: Handbook of Adhesive Bonding. McGraw-Hill, 1973.
3. Katz, I. and C.V. Cagle: Adhesive Material. Foster Publishing Company, 1971.
4. McGuire, P.E.: Adhesive Raw Material Handbook. Padrie Publishing, 1964.
5. Baier, R.E., E.G. Shafin, and W.A. Zisman: Adhesion: Mechanisms That Assist or Impede It. Science, 162:1360, 1968.
6. Hall, C.W., P.A. Cox, and W.A. Mallow: Skeletal Extension Development: Criteria for Future Designs. Bull. Prosth. Res., BPR 10-25, 69-96, Spring, 1976.
7. Hall, C.W.: Percutaneous Load-bearing Skeletal Extensions (PLSE). *In* David Williams (ed.), Biocompatibility of Orthopaedic Implants, 2, CRC Press, Cleveland, Ohio.
8. Laird, J.A. and F.W. Nelson: The Effect of Glass Surface Chemistry on Glass Epoxy Systems. Soc. Plastics Engrs. Trans., April, 1964.
9. Erickson, P.W., A. Volpe, and E.R. Cooper: Effects of Glass Surfaces on Laminating Resins. Modern Plastics, Aug., 1969.
10. Outwater, J. and D. Kellogg: A Simple Experiment to Show the Origin of Water Influencing the Debonding of Resin Against Glass. Report for Contract V-3219(01)(X). Sept., 1969.
11. Zisman, W.A.: Surface Chemistry of Glass Reinforced Plastics. NBL Report 6083, Symposium on Glass-Resin Interface of the Society of Plastics Industry, Inc. 19th Annual Exhibit and Conference. Chicago, Illinois. Feb. 6, 1964.
12. Laird, J.A.: Glass Surface Chemistry for Glass Fiber Reinforced Plastics. Final Report. Navy Contract W-0679-C(FBM). June, 1963.
13. Boyd, G.E. and H.K. Livingston: Adsorption and the Energy Changes at Crystalline Solid Surfaces. J. Am. Chem. Soc., 64:2383-2388, 1942.
14. Loeser, E.H., W.D. Harkins, and S.B. Twiss: Adhesion of Liquids to Solids. Molecular Interaction Between Metal Oxides and Adsorped Vapors. J. Phys. Chem., 57:251-254, 1953.
15. Basford, P.R., W.D. Harkins, and S.B. Twiss: Effect of Temperature on the Adsorption of N-Decane on Iron. J. Phys. Chem., 58:307-312, 1954.
16. Eley, D.D. and R. Radham: The Influence of Metal Oxide Films on the Wetting of Metal Surfaces by Adhesives. Symposium on Adhesion—Fundamentals and Practice. Maclaren & Sons, Ltd., London. 1969.
17. Wase, W.H. and H.J. Hocherman: A Microcalorimetric Study of Liquid Displacement Phenomena. J. Phys. Chem., 69:314, 1965.
18. White, M.L.: The Protection and Control of Organic Contaminants on Surfaces. Marcel Dekker, Inc. New York, 1969.
19. Kamahara, H.: Biological Test of Dental and Surgical Materials by Means of Tissue Culture. Second Proceedings of the Inter-Academy of Oral Pathology. 79, 1965.
20. Fisher, J.W. and T.W. Cooper: Electron Microscopic Studies of the Microvilli of HeLa Cells. J. Cell. Biol., 34(2):569, 1967.
21. Flaxman, B.A., M.A. Jutzner, and E.J. Banscott: Ultrastructure of Cell Attachment to Substrates *In Vivo*. J. Cell. Biol., 36(2):406, 1968.

SENSORY AIDS

Edited by
Howard Freiberger, A.M.
Acting Chief, Rehabilitation Engineering Service

Veterans Administration Prosthetics Center
252 Seventh Avenue
New York, N.Y. 10001

Clinical Application Study of Reading and Mobility Aids for the Blind
Eastern Blind Rehabilitation Center
West Haven VA Medical Center
West Spring Street
West Haven, Connecticut 06516
Donald E. Garner, William R. d l'Aune, Ph. D., and Patricia D. Gadbaw

Technology Transfer Activities

Current Research in Devices for the Blind

In July 1978, a meeting was held at the Army's Night Vision and Electro-Optics Laboratory at Fort Belvoir, Virginia. In attendance were Dr. William De l'Aune and Mary Dolan of the Eastern Blind Rehabilitation Center, Howard Freiberger and Ronald Arroyo of the VA Prosthetics Center in New York, and Dr. Vernon Nickel, VA Central Office. After brief introductory remarks by the VA visitors, the NV&EOL staff described some of their current research thought to be of value in the research and development of devices for the blind.

John Dehne, Chief of the Visual Perception Section, provided the group with information on the laboratory's work with "smart" sensors. Joseph Swistak, a perceptual psychologist, spoke of their simulation testing and evaluation method. Ray Balcerak, a specialist in the far infrared and advanced processing devices, reviewed recent developments in 3-D computer technology. He concluded that very fast, powerful computers would be available in the near future in compact, energy efficient packages, thus allowing additional sophistication in prosthetic devices of the future. Nicholas Diakides, an engineer/electrophysiologist, spoke of his work in the design of CRT phosphors (which have some of the characteristics of human visual receptors) for use in light amplification systems.

It was concluded that our first cooperative effort should be in the

evaluation of the ITT Night Scope, which is based on the light amplification technology developed at NV&EOL. Diakides and Swistak visited the EBRC in September and discussed this matter with Dr. De l'Aune, Mr. Freiberger, and Mr. Arroyo. They agreed that testing of the physical characteristics of the devices could be best carried out at Fort Belvoir and that such testing should be done before and after the devices' evaluation in the VA. Standard systems acceptance testing was conducted on three VA-owned Night Scopes in November 1978, prior to their being sent to the Western Blind Rehabilitation Center for preliminary evaluation.

Mr. Diakides has subsequently been given the responsibility for coordinating the NV&EOL side of what is perceived as a continuing cooperative effort between this Army group and VA Rehabilitative Engineering. A recent proposal from Dr. Diakides for a design study of a laser cane utilizing state-of-the-art components is a positive indication of their ability and interest.

Following a series of exploratory conversations with the Chief, Blind Rehabilitation, VACO, a project development engineer from Teleflex, Inc., Barry Barsky, visited the EBRC's research department. Sensitive to the fragile nature of braille watches for the blind, he proposed a wrist watch with an auditory output. The device would be hermetically sealed, have rechargeable batteries and a bi-tonal output code providing the user with the time in hour and five-minute increments. The projected cost for such a watch was given as fifty dollars.

The staff reaction to this concept was generally favorable, with some reservations. It was felt that the clients experiencing the most difficulty with conventional braille watches were the elderly, a group that might have problems in interpreting the tonal code. A voice output was suggested as an alternative, but price and size presented formidable obstacles. The second observation was that the large majority of blind clients could read the output of a digital watch if the visual display were slightly larger. The possibility of a dual modality output for the watch was to be seriously considered.

After further exploration of this concept, both in terms of engineering and marketing, Mr. Barsky returned to the Center in November. Simulated auditory outputs were provided for testing with blind consumers. Their interpretations of and reactions to the simulated tonal codes were very positive.

Electronic Mobility Aids

In July, Howard Freiberger and William De l'Aune met with Douglas Maure, Chief Engineer, American Foundation for the Blind, and John M. Simpson, Manager of the Optical Design Department of Bausch and Lomb. The purpose of this meeting was to discuss possible direction in electronic mobility aids for the blind and the role that

AFB Engineering could play. Mr. Freiberger and Dr. De l'Aune were able to provide the group with accounts of their experience with the currently available devices. Mr. Freiberger recounted the long history of engineering efforts aimed at assisting the blind traveler. Mr. Maure discussed the possibility of utilizing microprocessor technology to provide the user with a more sophisticated output from his environmental sensor. Mr. Simpson outlined the possibilities of an elaborate optical input system for such a device. Mr. Maure described an acoustical sensing system used by Polaroid having potential as an inexpensive input for an environment sensor for the blind.

AFB Glucose/Ketone Analyzer

In December, Dr. De l'Aune and Dr. Joseph Ventimiglia, staff physician at the EBRC, attended a meeting of the Medical Oversight Committee for the AFB Glucose/Ketone analyzer project. The meeting was held at Cornell Medical Center and was chaired by Aaron Bauch, Project Engineer from AFB, who described the system. Designed to be used by a blind diabetic, the device performs a colorimetric assessment of Ames Laboratories Diastix and Ketostix. It then audibly reports the concentrations of glucose or ketones to the user.

Input from the committee was sought on the value of a spoken versus a tonal output, the level of accuracy desired from such a system, and the feasibility of storage and statistical analysis of the test results for subsequent use by the physician. No firm conclusions were reached.

Other Activities

Dr. Robert J. Adrian, Coordinator of Psychological Services, and Dr. Laurence Miller, Supervisor of Psychological Services of the New York Association of the Blind, visited EBRC in July. The possibility of a cooperative effort in their proposed study, "The Utility of the California Psychological Inventory (CPI) and the Minnesota Multiphasic Personality (MMPI) in the Personality Assessment of Congenitally Blind Persons," was explored. Of particular interest to both groups were the development of norms for the CPI and MMPI applicable to blind clients and the investigation of the feasibility of using shortened or combined forms of the test for reducing the effort involved in administration and scoring of the instruments.

EBRC experience with computer analysis of such data and the expansion of the data base to include not only adventitiously blinded clients but also congenitally blinded individuals was seen as valuable by both parties.

In November the research department hosted a visit to EBRC by Mr. Keith Holdsworth of the Royal Guide Dogs for the Blind Associations of Australia. Mr. Holdsworth was primarily interested in re-

search concerning program evaluation. Consequently most of his time was spent in discussions of the EBRC's methods of computer processing patient information, including data concerning their satisfaction with the program.

Because of new developments in within-the-ear hearing aids, preliminary contacts have been made with Adrienne Karp, Audiologist, New York Association for the Blind. The possibility of a cooperative evaluatory project focusing on the directional performance of these aids when used by blind clients is being considered. The importance of this information to the auditorily impaired blind is considerable.

A character-recognition study utilizing the Kurzweil Reading Machine is currently underway in conjunction with the other two VA Blind Rehabilitation Centers.

Ms. Patricia Gadbaw served as a member of the program planning committee for the New England Chapter of the American Association of Workers for the Blind Annual Conference. She and Judith Green of the EBRC presented a seminar, "Practical Application of Optics through Case Presentations," at that conference which was held in Galilee, Rhode Island in September. Ms. Gadbaw also presented a seminar at the New England College of Optometry in Boston this December concerning the "Team Approach to the Low Vision Client."

An essay entitled "Research and the Mobility Specialist," was published in the September issue of the Journal of Visual Impairment and Blindness. This paper was adapted from a chapter by Dr. De l'Aune in the forthcoming book, Foundations of Orientation and Mobility, Richard Welsh and Bruce Blasch, editors.

Clinical Application Study of Mobility Aids for the Blind
Central Rehabilitation Section for Visually Impaired and Blinded Veterans
Hines VA Medical Center
Hines, Illinois 60141
John D. Malamazian and Leicester W. Farmer

The primary emphasis during this reporting period has been the training of blinded veterans to use electronic travel aids (ETA's). To this end, seven veterans were admitted to the Electronic Travel Aids Program at the Blind Rehabilitation Center at Hines, Illinois. Another veteran was evaluated with the Mowat Sensor and will return to the program after evaluation with the Sonicguide. Four veterans completed training with the Sonicguide and two others completed the Mowat Sensor training course.

A prototype Ultrasonic System (USS) was delivered to Leicester W. Farmer by Drs. G.F. Saletta and K. Haag, investigators from Illinois

Institute of Technology (IIT) Chicago, for evaluation and field testing. The USS is being developed to test the feasibility of providing information intermediate in complexity between that afforded by the Lindsay Russell Pathsounder and the Sonicguide. This will be achieved by representing distance, direction and size information by distinct bits, in contrast to the continuous overlapping output of the Sonicguide.

The initial phase of the project has been completed with the development of the simplest electronic system which would provide the desired information to the user. The purpose of this prototype is to evaluate the information coding scheme in dynamic situations, and to determine the electronic and ultrasonic problems which must be addressed and resolved to obtain a reliable system.

The USS detects objects in the environment by emitting bursts of ultrasonic energy; echoes are detected by receiving transducers and transformed into an audible code. This provides the user with information about the distance, direction and size of the target(s). The difference between this system and that of the Sonicguide is in the coding format which provides discrete bits of information rather than the continuous display of the Sonicguide.

Radial distances from the user of the device are divided into ten zones approximately 1.5 ft wide. The presence of an object in the nearest zone is coded as a low frequency tone (300Hz) while an object in the farthest zone is coded as a high frequency tone (3000Hz.) Distance information is enhanced by the coding scheme since the two different tones are separated in time by about a half second for objects in the nearest and farthest zones.

Objects in an intermediate zone are also coded as tones which are separated in time and frequency. The unique feature of the coding format is the presentation to the user of distance information in distinct tones which do not overlap in time.

The transducer arrangement in the USS is similar to that of the Sonicguide. Azimuth or directional information is achieved in the same manner; relative loudness of the signal in the two ears is the cue to the direction from which the tone is coming.

Information on the size of the object is coded as amplitude (volume) of tone presented to the user—large targets produce louder tones than do small targets.

Evaluation of the USS has begun and some of the observations made thus far are as follows:

1. Distance and direction, observed by the principal investigators, are relatively easy to distinguish;
2. Object size information is considerably more difficult to distinguish; and
3. The azimuth angle over which objects can be detected is approx-

imately ± 30 deg which is not wide enough to provide good stereo information about objects moving across the field of view.

Dr. John Armstrong, psychologist and researcher from Nottingham University, Nottingham, England visited Mr. Farmer at Hines to assess the current state of the distribution and training for the Sonicguide.

Another visitor from England, Alan Wedgbury, Mobility Officer for the Blind in Lincolnshire at Boston, England, also visited Mr. Farmer to get an update on ETA's, to get information about light probes, and to review training formats and evaluation procedures for ETA's during his week's stay at Hines.

Clinical Trials of Reading Machines for the Blind
Central Rehabilitation Section for Visually Impaired and Blinded Veterans
Hines VA Medical Center
Hines, Illinois 60141
John D. Malamazian and Harvey L. Lauer

The major focus continues to be evaluation of the Kurzweil Reading Machine for the Blind. The KRM at Hines continues to perform well and needed no servicing during this reporting period. Veterans here in rehabilitation training read with the machine, as do staff members. An intensive study of the column-reading feature led to the conclusions that the present feature is of token effectiveness, but that with reprogramming it should be more useful. With the hand-scanning option associated with the upcoming model, that feature should be highly useful. In August, John Malamazian and Harvey Lauer conferred in Boston with both VA and manufacturer's personnel regarding VA plans for purchase, evaluation and deployment of the new "desk top" machines. Mr. Lauer also conferred with Howard Freiberger of VAPC who was preparing documents regarding VA evaluation of the KRM and specifications for KRM purchase. A study was made here of print samples, several of which were submitted for inclusion as part of the specifications.

Mr. Lauer conferred with staff at the Western Rehabilitation Center in Palo Alto, California. He also visited the San Francisco Rehabilitation Engineering Center and Telesensory Systems, Inc., where sensory aids are being developed and produced. With Richard Bennett he tested the newly-received KRM at WBRC. As a result, service was requested and obtained from the manufacturer, to bring the machine up to specification.

Mr. Mowinski updated and expanded the Veterans Administra-

tion's consumer-oriented handouts about speech compressors and calculators for the visually impaired.

Mr. Lauer and Mr. Mowinski attended the Rehabilitative Engineering Conference in September in Washington, D.C. The program, exhibits and private conferences were unusually helpful. Mr. Lauer attended and participated in the convention of the National Federation of the Blind, in Baltimore, where he conferred with several developers of communication aids for the blind.

Two pre-market models of speech compressors were tested. One is a recorder-player with pitch-correction circuitry, tested for the American Foundation for the Blind. The other, being tested for the VA, is a new model of the Am-Bi-Chron speech compression module.

A prototype audible polyphonic output for the Optacon was built by Illinois Institute of Technology electrical engineering graduate student Bernard Vecerek. This very successful device connects to the I/O terminal of the Optacon to yield a 12-tone output similar to that of the Stereotoner. It permits an effective bimodal (touch and hearing) display providing simultaneous audible and tactile direct translation displays. So far, one Optacon student used the device as he learned the Optacon and prefers the two outputs used together. Each code renders certain letter features better than the other. Four Stereotoner users including Mr. Lauer and Ms. Butow prefer the audible code as rendered by the Optacon and the prototype over the code as rendered by the Stereotoner. Prospects for a useful addition to the Optacon appear highly promising.

Further testing is underway and plans are being made for testing the value of additional tones in the code.

IIT engineers are also working with Blind Center Personnel to interface a computer with devices including the ELINFA braille recorder so as to assess the value of upcoming braille and talking terminals.

A tracking aid has been adapted for use with the Optacon Reading Machine. The Colineator tracking aid, developed and manufactured by Mauch Laboratories, is a result of the Visotoner Reading Machine Project. It can now be used in conjunction with the Optacon Reading Machine. With the assistance of the model shop, Mr. Mowinski developed a coupler enabling the Optacon camera to be connected to the Colineator. The results were favorable. The students preferred the Colineator over existing tracking aids. It can be used when reading books as well as single sheets of paper.

Clinical Application Study of Reading and Mobility Aids
Western Blind Rehabilitation Center
Palo Alto VA Medical Center
3801 Miranda Avenue, Palo Alto, California 94304

J. Kenneth Wiley, Gregory L. Goodrich, Ph. D., Richard R. Bennett, and H. Stanton Paul

Kurzweil Reading Machine

During the current reporting period, all research staff have attained proficiency in the use of the Kurzweil Reading Machine (KRM). In addition, four visually impaired staff have received training in the use of the machine and numerous demonstrations have been made to blinded veterans.

In July 1978 Mr. Harvey Lauer, Reading Machines Specialist, VAMC, Hines, Illinois visited the WBRC to facilitate Mr. Bennett's and Dr. Goodrich's orientation to the KRM and to compare the functioning of the KRM's at Hines and Palo Alto. Using materials which had been read by the KRM at Hines, it was quickly established that the WBRC's KRM was not operating satisfactorily. A visit by Mr. Max Dannis (Kurzweil Computer Products staff member) revealed a malfunction in the central processing unit and repairs were made. Subsequent performance tests compared favorably to performance by the Hines' KRM.

In accordance with the purchase agreement, Kurzweil Computer Products supplied an RS-232 cable and software program ("Text to Speech") which allows the KRM to function as a voice-output for the WBRC's Tektronix 4051 computer. This interactive arrangement became operable on November 22, 1978, and provides the Tektronix with a "talking computer terminal" allowing it to function as an editor for composition and editing of text by visually impaired users. Among the features are storage and retrieval of large volumes of information, automatic text or letter formatting, and error correction using a voice (or visual) display. It is expected that these features will be available for use by WBRC staff, as well as demonstrating the versatility of computers adapted for use by the visually impaired.

In September 1978, Dr. Goodrich and Mr. Bennett proposed a formal study of the KRM's in use at each of the VA's BRC's. The design allows measurement of optical character recognition (OCR) errors with different type styles and/or print media. The purposes of the cooperative study are to evaluate OCR error rate, compare performances between KRM's, and to evaluate the effectiveness of the KRM "learning" feature. The study will be concluded by all three BRC's in the first quarter of calendar year 1979. Results should be helpful to KCP design and engineering staff, as well as enabling the VA to compare performance on its three KRM's. The OCR error-rate protocol contains extensive definitions of errors and defines optimum contrast setting, thereby allowing comparisons between machines in widely differing locations. It also has the capability of aiding evaluations between different models or brands of reading machines.

ELINFA Digicassette

An ELINFA Digicassette has been undergoing evaluation at the WBRC during the current reporting period. In general the braille display has been of high quality. Two cells, however, of the 12-cell display developed a variable response requiring repair by ELINFA. The unit was shipped for repair in September and returned in November but one pin in one cell continued malfunctioning. The unit was again returned to ELINFA in November and received back at the WBRC on December 28, 1978. At that time the unit was functioning with a legible braille display.

Optacon

During the current reporting period, one veteran received 80 hr of Optacon instruction and was issued an Optacon. Upon completion of training he was reading test material at approximately seven words per minute.

ETA Followup

The electronic travel aid followup study was completed early in the reporting period, with a total of 101 visits to veterans who had been trained in orientation and mobility by WBRC staff. The visits were made to veterans using electronic travel aids and to electronic travel aid non-users, so that a control population would be available for data analysis and interpretation. The results of the followup will be analyzed as soon as possible.

The WBRC electronic travel aid program continued evaluating and training veterans in the use of these supplemental mobility aids. Between July 1 and December 31, 1978, five veterans were trained in the use of the Mowat Sensor, with Mowats being issued to three. Two additional veterans received training with (and were issued) the Sonicguide.

IT&T Clinical Pocketscopes

Also during that period three IT&T Clinical Pocketscopes were received at the WBRC for investigation of their efficacy as travel aids for "night blind" veterans. In October the three devices were shipped to the U.S. Army Night Vision and Electro-Optics Laboratory, Ft. Belvoir, Virginia, for calibration testing by Mr. Nicholas Diakides. The devices and their calibrations were returned to the WBRC in early December. During this time, the WBRC developed an outdoor mobility run for testing the effect of the devices on veterans' travel performances, and an objective scoring system for the run. An indoor experimental course was also developed. Upon completion of the WBRC's evaluation of the scoring procedure and the three Pock-

etscopes, the protocol and one device each will be shipped to the EBRC, West Haven, Connecticut, and CBRC, Hines, Illinois, for further evaluation. In November Mr. Paul Lighty, Program Manager of IT&T's Night Vision Aids Program, visited the WBRC to discuss their program and the evaluation being developed at the WBRC.

Personal Information System

The development of a "personal information system," a computer-based storage and retrieval system with multiple input/output formats, has begun. Currently Dr. John Linvill (Project Leader at Stanford University) and Mr. Greg Fowler are utilizing a PDP-11 computer to develop a simulated system so that initial design criteria can be developed and the necessary components of a personal information system designed.

CCTV

Data analysis of information on 96 experienced closed-circuit television (CCTV) users has been completed. The mean length of time subjects had their CCTV was about 4 yr. The data indicate that 87 percent of these users have continued using the CCTV on a regular basis over this period. It may be concluded that CCTVs are an extremely useful aid, and that use patterns are at least as good as (and perhaps better than) those developed with conventional optical aids.

The Development of Improved Techniques for the Analysis of Hearing Aid Performance

Biocommunications Laboratory
University of Maryland
College Park, Maryland 20742

Washington, D.C. VA Medical Center
Washington, D.C. 20422

G. Donald Causey, Ph. D., Jerry L. Punch, Ph. D., Howard C. Schweitzer, Ph. D., Earleen Elkins, Ph. D., and Lucille Beck

The Clinical and Acoustic Parameters of Hearing Aid Performance

Study of Transient Distortion

A portion of this work has been aimed at developing a means of quantifying transient distortion in hearing aids and applying the transient distortion data to an investigation of the relation of this form of distortion to listeners' perception of speech quality.

Success in reaching these goals was facilitated by recent research

conducted by Talkin and Opauski (1977) at Gallaudet College. Their work was aimed at developing a digital inverse-filtering technique that might be used in hearing aid frequency response measurements. Their general aim was to achieve a flat-spectrum broadband signal, to serve as the acoustic input to the hearing aid in the conduct of frequency response testing. We have adapted the technique, which makes use of impulse technology, to our work in transient distortion. The method is described in detail by Talkin and Opauski (1977).

Using this digital technique, the impulse response of 20 conventional, noncompression, over-the-ear hearing aids was measured. For these preliminary measurements, gain controls were set to the test-reference position specified by the ANSI S3.22 (1976) Standard. Standard No. 13 tubing was used in conjunction with a Zwislocki-type occluded-ear simulator. Output level was held constant at 80 dB peak-equivalent SPL, re the amplitude of a 1 kHz tone. Output impulse responses of the aids were digitized and stored in the computer. Storage in computer memory means that subsequent analysis of the data can be virtually instantaneous, a distinct advantage of the method.

Four different optimization algorithms were used to match the actual signals measured to an approximated second-order linear system impulse response. These optimizations yielded three parameters that were ultimately used to specify the impulse response of the aids tested: (1) β, a decay constant (related to decay time, or ring time), (2) w, the number of zero-crossings in the impulse response divided by time, and (3) w_p, the zero-crossings in the differenced impluse response divided by time. Values on each of these parameters differed substantially across the 20 hearing aids.

Therefore a method that appears to hold promise in offering a means by which transient response in hearing aids may be quantified has been found. Furthermore, several specific parameters associated with the impulse response have been identified.

These data were analyzed in terms of their effect on listener judgments of speech quality in the context of a larger experiment, the results of which are discussed below.

Speech Quality Judgments and Hearing Aid Electroacoustic Characteristics

Previous research has established that listeners' subjective preferences for hearing aids, based on the quality of speech transduced by the instruments, are reasonably strong in differentiating among different aids, and are reliable indices of behavioral performance, particularly if obtained by a paired-comparison procedure (Witter and Goldstein, 1971; Punch, 1978). The basis for a listener's judgment that aided speech is of high or low quality, however, is largely unknown. This lack of information led to the investigation of quality

judgments of hearing aid-processed speech as related to the electroacoustic characteristics of hearing aids, in order to determine those characteristics responsible for producing improved speech quality. A post hoc multidimensional scaling technique was used in the data analysis.

Each of 20 conventional hearing aids, 16 of which were on VA contract, was subjected to an extensive electroacoustic analysis. Measurements included low and high-cutoff frequency; bandwidth; Index of Response Irregularity (IRI, as specified by Jerger and Thelin, 1968); total harmonic distortion at 500, 800, and 1600 Hz; intermodulation distortion at f2-f1, f1+f2, 2f1-f2 and 2f2+f1; equivalent input noise level (L_n); and three measures of transient response, β, w, and w_p, as described in the preceding section. Measurements, in general, were made with the aid situated on the acoustic manikin KEMAR (Burkhard and Sachs, 1975) at input signal levels and gain controls set according to the ANSI S3.22 (1976) Standard, where applicable.

A single 20-sec passage of connected discourse was processed by the hearing aids and tape-recorded via KEMAR in paired-comparison format. Each of the 20 aids was randomly paired with every other aid, for a total of 190 pairings. The recorded signals were delivered at a comfortable listening level through a wideband external-type hearing aid receiver attached to standard custom-fitted earmolds. A ⅓-octave spectrum equalizer was used in the playback system to adjust the receiver to an effective flat response on a Zwislocki-type occluded ear simulator.

Ten normal listeners and ten listeners with high-frequency sensorineural hearing loss were instructed to make sound quality judgments of preference and similarity for each of the 190 paired comparisons. Both types of judgments were made by the subject during presentation of a given paired comparison. Three replications were performed on each subject, one per test session, with data analysis based only on the latter two replications.

The mean similarity ratings of replications 2 and 3 were analyzed by use of INDSCAL (Carroll and Chang, 1970), a scaling technique whose output is a graphic reconstruction of the stimuli (20 aids) in a multidimensional psychological space. For normal listeners, the mean correlation within subjects between ratings in sessions 2 and 3 was .84, and the mean correlation among subjects was .74. The normal listeners therefore were a highly reliable and homogeneous group. The hearing-impaired subjects produced somewhat less reliable similarity judgments: their mean correlation between the second and third sessions was .70, and the correlation among subjects was .60.

Three-dimensional solutions were selected for the primary analysis because higher dimensional solutions yielded no appreciable increase in goodness of fit. For normal listeners, the three-dimensional solu-

tion explained 71 percent of the variance. The most salient dimension, D1, correlated .91 with low-cutoff frequency. Subjects assigned ratings of "most dissimilar" to the hearing aids when the aids differed in this specific characteristic. Therefore, the data indicate strongly that normal listeners utilized low-cutoff frequency as one of the bases for their judgments. Similarly, IRI and L_n appeared to be the bases for D2 and D3, with correlations of these factors with the dimensions being .66 and .63, respectively. Preference data indicated essentially identical bases for preference judgments, as normal-hearing subjects preferred aids with lower low-cutoff frequencies, less irregular responses, and reduced equivalent input noise level.

The pattern observed for the ten listeners with sensorineural hearing loss was similar with respect to only one dimension, low-cutoff frequency. This was the only dimension that could be clearly labeled by the analysis, which showed a correlation of .86 between D1 and low-cutoff frequency. As in the case of normal listeners, this group of listeners subjectively preferred aids with extended low-frequency emphasis. It must be emphasized that this conclusion must be limited for the present time to subjects having high-frequency sensorineural loss, with relatively good hearing in the low frequencies, and to the closed earmold condition studied in this specific experiment. (For this reason, a group of hearing-impaired listeners having relatively flat audiometric configurations are currently being tested under identical conditions.)

Transient response, the topic of the preceding section, did not emerge as a dimension for either subject group as a basis of speech quality. If the derived indices of transient response adequately represent differential transient characteristics of the hearing aids studied, the preliminary results indicate that transient response is not a dominant characteristic in speech quality judgments, at least for conversational-level speech in quiet. The area of transient distortion deserves additional study in this regard, particularly as related to measurement technique and application of the data to situations involving speech in the presence of background competition.

References

American National Standards Institute. Specification of Hearing Aid Characteristics. ANSI S3.22—1976, New York, 1976.

Burkhard, M. D. and R. M. Sachs: Anthropometric Manikin for Acoustic Research. J. Acoust. Soc. Amer., 50:214-222, 1975.

Carroll, J. D. and J. J. Chang: Analysis of Individual Differences in Multidimensional Scaling Via an N-Way Generalization of "Eckart-Young" Decomposition. Psychometrika, 35:283-319, 1970.

Jerger, J. and J. Thelin: Effects of Electroacoustic Characteristics of Hearing Aids on Speech Understanding. Bull Prosth. Res., BPR 10-10:159-198, Fall 1968.

Punch, J.: Quality Judgments of Hearing Aid-Processed Speech and Music by Normal and Otopathologic Listeners. J. Amer. Audiol. Soc., 3:179-188, 1978.

Talkin, D. and M. Opauski: Application of Digital Inverse Filtering Techniques to Sound Field Spectral Flattening. Paper pres. at 94th meeting of the Acoust. Soc. Amer., Miami, 1977. J. Acoust. Soc. Amer. 62 (Suppl. 1): S12, Fall 1977.

Witter, H. L. and D. P. Goldstein: Quality Judgments of Hearing Aid Transduced Speech. J. Speech Hearing Res., 14:312-322, 1971.

The Application of the Maryland Speech Intelligibility Materals

A. In Dichotic Listening

The effect of dichotic amplification on the speech discrimination ability of hearing-impaired subjects was examined in this study by means of comparative evaluation with monaural and binaural amplification. The speech discrimination scores of 12 subjects with sloping sensorineural hearing loss were measured in quiet and speech-babble competing-message listening conditions for monaural, binaural, and dichotic amplification modes.

A 2-channel device, consisting of a master hearing aid and digital multifilter with hearing-aid microphones and receivers mounted in post-auricular hearing-aid chassis, provided amplification in the 3 modes. One channel of the device was used for monaural amplification while both channels were used for binaural amplification. For the dichotic amplification mode, the frequency response was divided at 1000 Hz and 1 channel of the device delivered the low-frequency portion of the signal while the other channel simultaneously delivered the high-frequency portion of the signal. Electroacoustic measurements were obtained to ensure that Saturation Sound Pressure Level, total harmonic distortion, inherent noise values, and frequency response characteristics as a function of volume control setting were similar for the amplification modes.

Subjects were seated in a foam-insulated IAC room, equidistant 1 meter from 4 loudspeakers, at 0 deg, 90 deg, 180 deg, and 270 deg azimuth. The speech discrimination stimulus, the Maryland recording of the CNC lists, was presented through the 0 deg azimuth loudspeaker. Noncoherent speech babble was delivered through the other 4 loudspeakers in the competing message condition. Functional gain measures were obtained to ensure that real-ear frequency-gain characteristics were essentially equivalent for the 3 amplification modes. Seven subjects returned for replication of experimental procedures to evaluate test-retest reliability.

A two-factor analysis of variance and the Newman-Kuels multiple range test were used to analyze the data. A Pearson product-moment correlation coefficient was computed between test and retest speech discrimination scores.

Significant differences in speech discrimination ability were not obtained among the amplification modes in quiet. In the competing message condition, the dichotic amplification mode was significantly

better than the monaural mode and the binaural mode was also significantly better than the monaural mode. Significant differences in speech discrimination ability were not observed between the dichotic and binaural modes in the competing message condition. However, a trend favoring the dichotic mode was evident in the data.

A Pearson product-moment correlation coefficient (r) was computed between the word discrimination scores measured on the experimental test and the scores measured on the retest for seven subjects. The test-retest reliability coefficient of .95 was significant ($p<0.05$). The high correlation coefficient obtained on the test-retest conditions indicates that the experimental test procedure was reliable.

A t-test for testing differences between correlated variances was used to determine whether or not the subjects' variance on performance of the task changed from test to retest (Guilford, 1973). A non-significant t-ratio of .46 ($p>0.05$) indicated that there was no significant difference in subjects' variability from test to retest. In other words, the group variance was similar from test to retest.

Correlational analyses indicated that speech discrimination performance in one amplification mode for both quiet and speech-babble competing message listening conditions was highly related to speech discrimination performance in the other amplification modes. This result was particularly meaningful for dichotic amplification since it implied that the subjects in this study were able to discriminate speech with dichotic amplification in a manner closely related to speech discrimination in the more traditional monaural and binaural amplification modes.

B. In Monaural-Binaural Hearing-aid Performance

A total of 50 subjects participated in four experiments examining speech discrimination ability and/or localization response time to determine if the use of binaural aids would demonstrate an advantage over monaural aids. In the first experiment 5 loudspeakers were used, the signal emanating from each loudspeaker in turn. Uncorrelated babble from all 5 loudspeakers served as the competing message. In the second experiment 3 loudspeakers were used with the signal coming from the loudspeaker positioned at 0 deg azimuth and the babble coming from the loudspeakers at 315 deg and 45 deg azimuth. In the third experiment the same loudspeaker configuration was used to determine the effect of two different competing messages on the binaural and monaural modes. In the fourth experiment a signal below the average conversational level was used to determine differences between binaural and monaural listening. In the first two studies subjects were selected who had symmetry between ears; in the last two studies, subjects were selected if a hearing aid could be fitted for each ear without regard to symmetry.

In each instance, the differences between the group means ranged from 5.6 percent to 12 percent improvement in speech discrimination in favor of binaural amplification. With 6 percent improvement as the criterion, within each experiment, from 50 to 100 percent of the subjects obtained binaural performance scores better than monaural scores. Individual improvement ranged from 6 to 23 percent. These benefits were present even without an opportunity for prior practice with binaural aids.

With regard to localization, all of the subjects made correct responses as to speaker location whether they wore monaural or binaural aids. However, with the binaural aids, the responses were significantly faster.

It is believed that with proper selection of stimulus, competing message, loudspeaker location, and hearing aids, audiologists will be able to determine which patients have sufficiently better performance to warrant consideration of binaural hearing aids. This can be accomplished without taking advantage of head shadow effects. The binaural benefit does exist for some patients and can be demonstrated clinically through discrimination tests with competing messages. The ease of listening and improved quality of sound reportedly gained through binaural amplification have yet to be quantified.

In analyzing the results of these four studies the following statements appear most salient:

1. Localization response time is significantly improved with binaural hearing aids.
2. A test paradigm utilizing the Maryland CNC Test presented in presence of competing messages is effective in demonstrating clinically the benefits of binaural amplification.
3. Although it is possible to demonstrate a binaural advantage with a three loudspeaker arrangement, the most successful test configuration incorporated the 5 loudspeaker design with stimuli coming from each loudspeaker in turn. However, head-shadow effects made a contribution in the latter configuration.
4. Stimulus presentation levels that are lower than those usually employed clinically do not further enhance the demonstration of binaural advantage.

Interlist equivalency of the Maryland recordings of the CNC lists was demonstrated in the first experiment. Average scores ranged from 72.7 to 76.7 percent in the presence of babble.

Although interlist equivalency had previously been determined by Bender (1977), his research was conducted using low pass and speech spectrum noise.

All lists were within plus or minus 2 percent of the overall mean of 74.6 percent. Further work is necessary before the Maryland CNC

Test can be recommended for tasks different from those discussed above.

Selected Bibliography

Bender, D. R.: The Effect of Several Competing Signals on Aided Hearing Performance, Doctoral Dissertation, University of Maryland, 1977.

Carhart, R.: Discussion on the Round-table. Int'nl Audio., 6:285-289, 1967.

Mills, A. W.: On the Minimum Audible Angle. J of the Acoust. Soc. Amer., 30:237-246, 1958.

Olsen, W. and R. Carhart: Development of Test Procedures for Evaluation of Binaural Hearing Aids. Bull. Prosth. Res., BPR 10-7: 22-49, Spring 1967.

Development of a Hearing Aid System with Independently Adjustable Subranges of its Spectrum Using Microprocessor Hardware

Department of Electrical Engineering
Illinois Institute of Technology
Chicago, Illinois 60616
Daniel Graupe, Ph. D.

Biocommunications Laboratory
University of Maryland
College Park, Maryland 20740

VA Hospital
Washington, D.C. 20422

G. Donald Causey, Ph. D.

Previous work by this group on the generation and mixing of harmonics and subharmonics indicates the possibility that speech spectrum contraction may be incorporated into this prognostic device. Again, this feature would be fully controllable, permitting optimization of the signal for the hearing-impaired veteran who has only frequencies below 1 kHz remaining.

Digital Spectrum Shaping and Contraction Applied to Audiological Instrumentation

From July 1, 1978 to December 31, 1978, the project efforts have been mainly on completing the design for digital deterministic spectrum-shaping and the system for producing known amounts of nonlinear distortion. The work on these two systems is a continuation of the research begun when Dr. Graupe was Professor of Electrical Engineering at Colorado State University, Fort Collins, Colorado. The digital microprocessor-based control system for the distortion

generator is capable of producing harmonic distortions of speech or other acoustic signals at controllable amplitudes and at controllable ranges of the frequency spectrum, the control and mixing with the original speech signal being operated by digital keyboard. This device similarly provides for generating subharmonics of speech and other audio signals, again at controlled amplitudes and frequency ranges, and mixing these with the original speech signal for experimental purposes.

The design for optimal staircase fitting of spectra uses microprocessor hardware to achieve a small audiometric device. Here, control of overall frequency range and staircase width are provided, as is the coding and generation of signals that control amplitudes, facilitating a keyboard-operated mapping of optimal amplification for the individual patient.

Research on Audible Outputs of Reading Machines for the Blind
Haskins Laboratory, Inc.
270 Crown Street
New Haven, Connecticut 06510
Franklin S. Cooper, Ph. D., Andrea Levitt, Ignatius G. Mattingly, Ph. D., Patrick W. Nye, Ph. D., and Linda Shockey, Ph. D.

This research project has been terminated. A final report will appear in a future issue of the BPR.

VETERANS ADMINISTRATION PROSTHETICS CENTER REPORT

Anthony Staros, M.S.M.E., Director
Edward Peizer, Ph. D., Deputy Director

Edited by Max Nacht, Technical Writer/Editor, VAPC

VA Prosthetics Center
Veterans Administration
252 Seventh Avenue
New York, NY 10001

I. DEVELOPMENT AND EVALUATION
- A. Prosthetics
  - Lower Limb
    - Nylon Knee Joint
- B. Orthotics
  - Lower Limb
    - Plastic Knee Orthosis
- C. Spinal-Cord-Injury Rehabilitation
  1. Environmental Control Systems
     - a. UCSB Commander Word Recognition System
     - b. Speech Recognition and Control System
     - c. Power Access Door Opener, Model 4300
  2. Communication Aids
     - a. CommunicAid
     - b. Easicorder Model REC-1
     - c. Monitec Emergency Systems
  3. Mobility Aids
     - a. MED Quadriplegic Wheelchair System
     - b. Mobilpodium Mark III
     - c. Chin Control Powered Swing Away
     - d. Folding Rollator
     - e. Supermark Delta
     - f. Safety Rolling Walker
     - g. Centauri Freewheeler
     - h. Independence Walker
     - i. Moto-Stand
     - j. VAPC Powered Ambulator

k. Gad-A-Bout
4. Body Supports
a. Nitto "No Sore" Cushion Pad
b. ROHO Dry Flotation Cushion
c. Pneumatic Lifter Seat
d. Babette Bath
5. Lifts and Transfer Aids
a. Mann's E-Z Way Chair Lift
b. Wilson Transporter
c. Garaventa Wheelchair Elevator
d. Tuba-Chair
e. Stretcher Chair
f. Stretchair
6. Miscellaneous
a. Pulsemeter
b. Pulse Watch
c. Touch-Lite
d. Wheelchair Scales
II. COMPLIANCE TESTING
Shrinkage Tests
a. Herringbone Corset Material
b. Coutil Corset Material
c. Stump Socks
III. THE VAPC CLINIC TEAM

I. DEVELOPMENT AND EVALUATION

A. Prosthetics

Lower Limb

Nylon Knee Joint. Nylon knee joints (BPR 10-29, page 80) are currently being evaluated by two below-knee amputees using conventional leather corsets. The nylon knee joints were shaped at room temperature with conventional bending tools; no breakage occurred. When incorporated with the leather corset, the knee-joint side bars seem to have the rigidity required to provide support and suspension for the average below-knee amputee.

After 6 months use, the knee joints are functioning very well with no signs of wear and tear. The evaluation process will continue to further test the durability of nylon knee joints.

B. Orthotics

Lower Limb

Plastic Knee Orthosis. This knee orthosis (Fig. 1) offers a unique

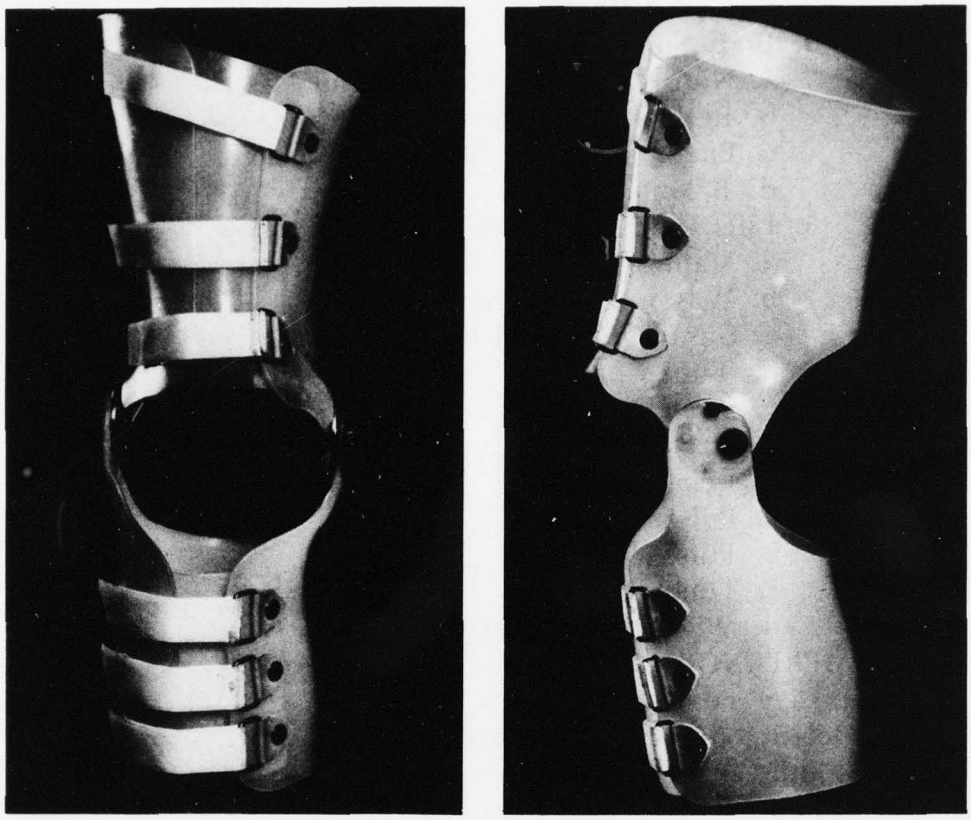


FIGURE 1.—Genucentric knee orthosis offers a unique polycentric joint.

polycentric (genucentric) joint as an alternative to single axis or conventional polycentric joints for mediolateral instability or genu recurvatum patients (BPR 10-29, page 81).

The genucentric[a] knee orthosis is lightweight, has improved cosmesis, and uses a supracondylar-suprapatellar suspension system. A unique knee-tracking capability, with its suspension mechanism, eliminates pistoning at the orthosis/limb interface. The most distinct feature of the genucentric joint is its ability to aproximate its instantaneous center of rotation with a structurally sound and/or pathologically deranged knee.

Clinical results indicate that this orthosis significantly improves comfort when compared to the more common knee orthoses. Pistoning and migration are reduced to the point of becoming undetectable. A full report of its clinical evaluation and fabrication technique has been prepared and is being submitted for publication.

[a]This term is used to distinguish the VAPC's unique polycentric knee joint from those now in common use.

C. Spinal-Cord-Injury Rehabilitation

1. Environmental Control Systems

a. *UCSB Commander Word Recognition System.* This eight-word environmental control system (Fig. 2) was designed and developed under VA contract by the Department of Mechanical and Environmental Engineering, University of California at Santa Barbara. A microprocessor and associated electronics recognize a vocabulary of eight voice command words: ON, OFF, CHANGE, LIGHT, NURSE, EMERGENCY, TV and BED; then control and operate the desired functions.

The system consists of a microphone, an acoustic word recognition module with display panel (for "training"), a display module, and an environmental device controller. The acoustic word recognition module accepts the voice command word from the microphone in analog signal form, converts this signal to a corresponding digital code word, and sends the digital code word to light the appropriate word on the display module, and to the environmental device controller. The environmental device controller accepts the digital code from the recognition module and provides the necessary power to operate the pertinent device or devices while providing a lighted display to indicate its operational status.

The system must be programmed to recognize the user's voice through a "training" procedure. This training procedure consists of placing the system in its training mode, then the user repeats each



FIGURE 2.—UCSB Commander Word Recognition System recognizes a vocabulary of eight voice command words.

word in the system's vocabulary eight times, following the system's prompting. When the system requires additional training, it indicates the word or words that must be repeated. Upon completion of training, the Commander automatically shifts to its recognition mode. It is then ready to respond.

A typical command requires recognition by the device of a sequence of words. For example, to lower the head of his bed, the user voices the words "bed," (causing the BED and HEAD UP lights to come on) "change," (causing the HEAD UP light to go off and the HEAD DOWN light to come on) "on," (causing the head of the bed to begin going down) and "off" (causing the bed to stop and all lights to go off).

Laboratory tests indicate that the system correctly recognizes any given word in its vocabulary 86 percent of the time, and correctly rejects any given word that is not in its vocabulary 88 percent of the time. Clinical trials are currently being conducted at the VA Medical Center, Castle Point, New York.

b. *Speech Recognition and Control System.* This sophisticated system (Fig. 3), developed under VA contract by Dialog Systems, Inc., Belmont, Mass., is designed to recognize large numbers of words (up to 100) when spoken by different users without extensive training (BPR 10-23, page 248). The system primarily consists of two minicomputers, a floppy disc drive, and a special analog-to-digital converter, all in a single cabinet, and a microphone, display panel, teletype and color TV monitor outside the cabinet.

The user's commands appear on the display or monitor in word, letter or number form so that the user knows if his command has been recognized correctly. The monitor also indicates which words from the syntax tree are available next. The syntax tree (Fig. 4) is a hierarchy of the words that the system can recognize. This hierarchy reduces the available vocabulary at any given time, which results in an improved recognition rate.

The Speech Recognition and Control System interfaces with a complete VAPC home environmental control section; a teletype section that types all letters, numbers and punctuation; a calculator section that generates the four basic functions plus trigonometric and logarithmic functions; a telephone; and two games that allow the user to match wits with the computer. The system is programmed such that it can use implicit training, i.e., the computer improves its recognition of the user's voice as he talks; or it can use rote training, where the user trains the system directly by repeating each word in a subsection of the vocabulary three times.

The Speech Recognition and Control System has undergone

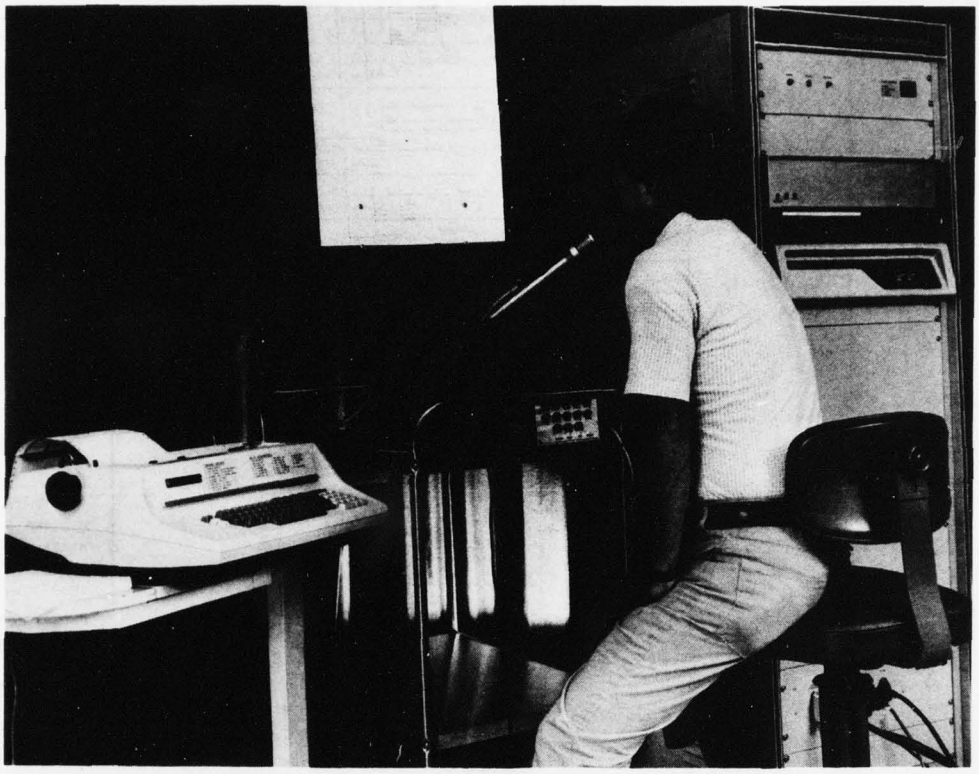


FIGURE 3.—Speech Recognition and Control System recognizes up to 100 words when spoken by different users without extensive training. "Syntax tree" (see Figure 4) is mounted in front of microphone.

laboratory testing and is currently undergoing clinical trials at the VAMC, Castle Point, New York.

c. *Power Access Door Opener, Model 4300.* The Model 4300 automatic Power Access Door Opener (Fig. 5) for interior doors in private homes and institutional buildings, manufactured by Power Access Corp., Eatontown, New Jersey, employs a 115 V a.c. electric motor that can be controlled via wall switches, floor-mat switches, electric eye or radio control. Its operation can be coordinated with an electric door lock. The unit is mounted above the doorway on the side from which the door is pushed open, and a standard hydraulic closer is used to close the door.

Two units will undergo tests for safety and reliability at the VA Medical Centers at Castle Point and St. Albans, New York. Clinical trials will begin after the units have been successfully tested.

2. *Communication Aids*

a. *CommunicAid.* This portable voice amplifier, developed for A. R. Mann of Decatur, Ill., its sole distributor, consists of an amplifier,

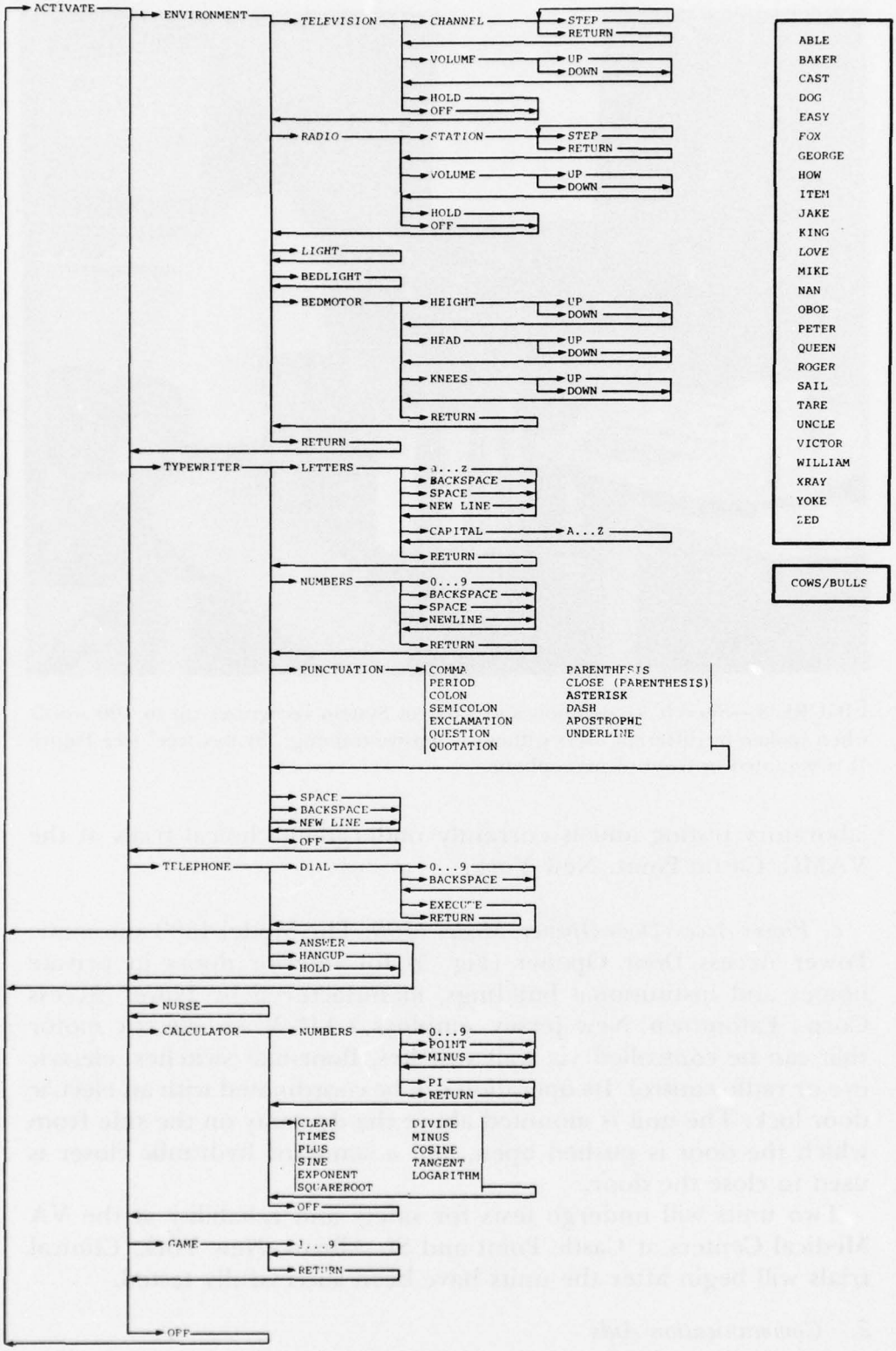


FIGURE 4.—The "Syntax Tree" is a hierarchy of the words recognizable by the system.

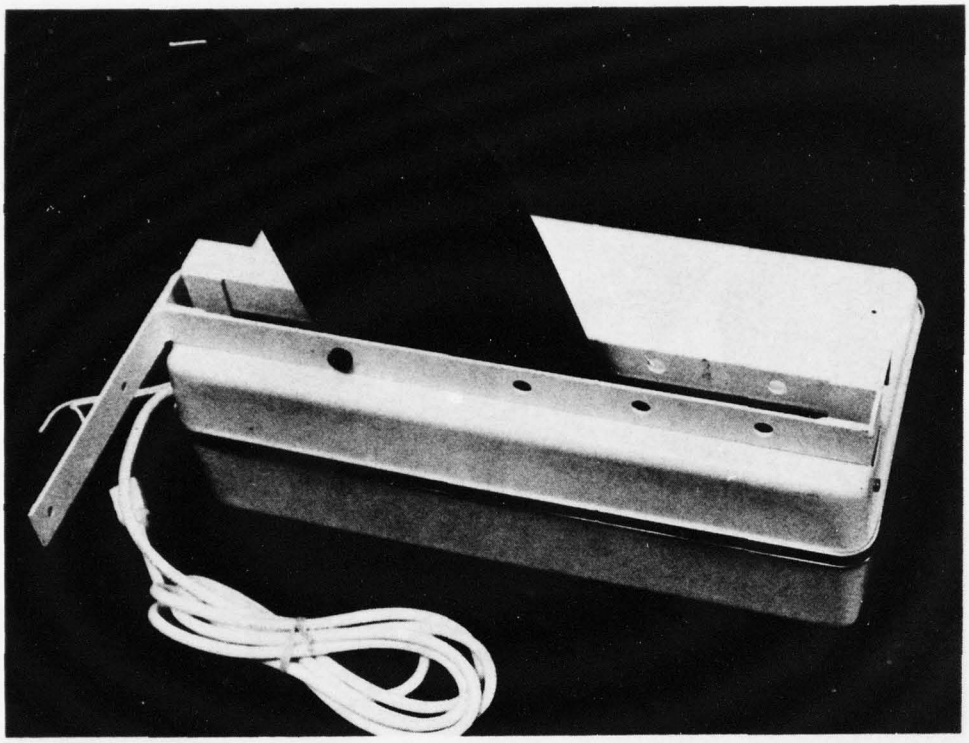


FIGURE 5.—Power Access Door Opener, Model 4300 for interior doors.

speaker and a 9-V battery housed in a formed 6-oz aluminum case that clips onto a belt or pocket, and a microphone. Two microphones are available: a small hand-held capacitive type and a very small one that clips onto eyeglass frames and has an acoustic tube that extends to the corner of the mouth (Fig. 6) for hands-free operation. The device is currently being evaluated.

b. *Easicorder Model REC-1.* Manufactured by Romich, Beery and Bayer, Inc., Shreve, Ohio, this cassette tape recorder (Fig. 7) is designed primarily for use by handicapped students. Once a cassette has been placed in the machine, a single switch controls all functions through a scanning arrangement. The functions include: on/off, play, record, fast reverse, fast forward, fast play, underline and channel selection.

Unlike standard cassette tape recorders, the Easicorder can reverse tape direction automatically when it reaches the end of the tape, thereby obviating the need to turn it over to record on both sides. The Easicorder uses each of four channels of a stereo recording head to record monaurally so that it can record for twice as long as the nominal duration of the tape. A special underlining feature makes it easy for the student to select important sections of the tape for review:

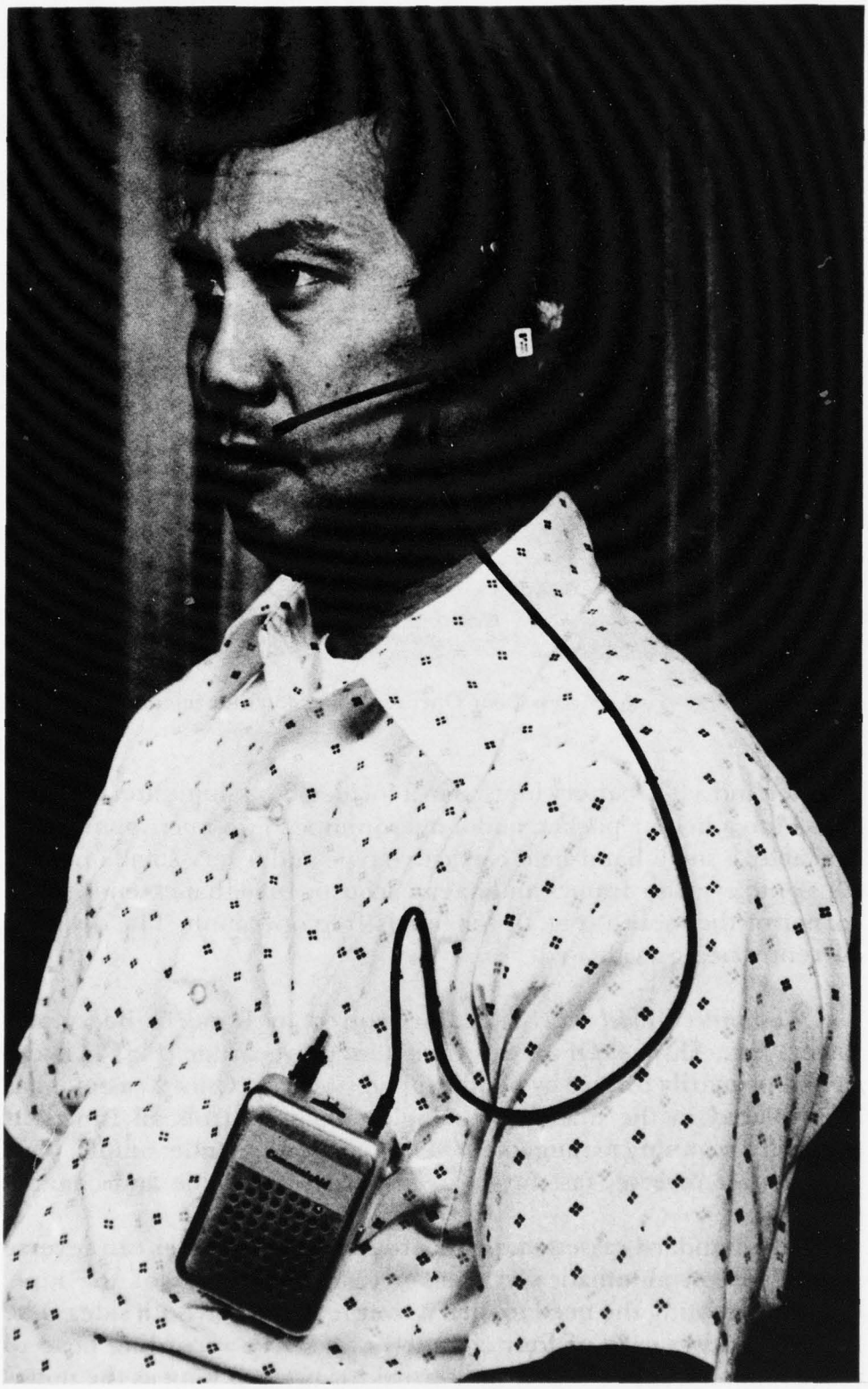


FIGURE 6. — CommunicAid portable voice amplifier

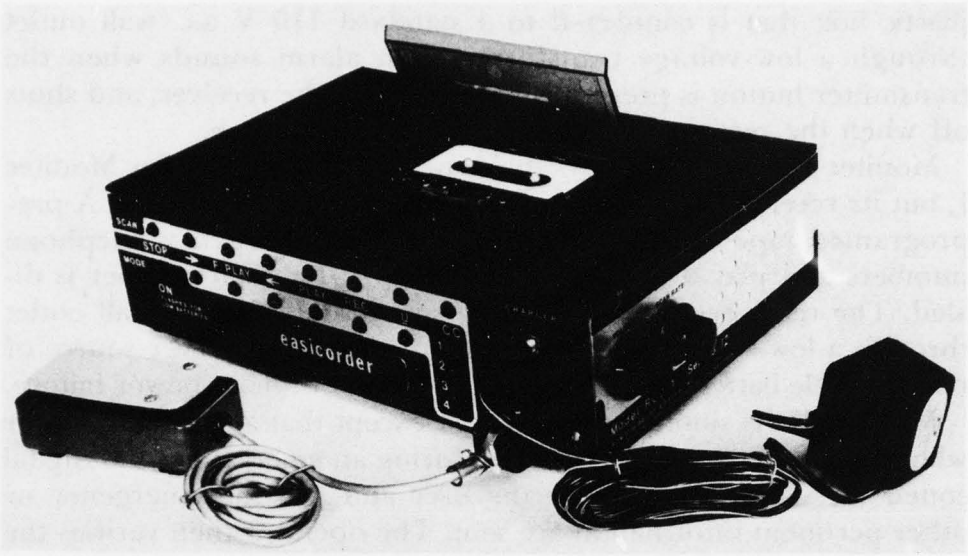


FIGURE 7. — Easicorder Model REC-1 cassette tape recorder.

four inaudible low-frequency beeps are placed on the tape while recording or playing back. When played back in fast play, the frequency of the beeps is increased and they become clearly audible. Because the user normally places these beeps on the tape after the start of an important section, the recorder automatically skips from fast play to fast reverse when the switch is depressed, then skips into normal play when the switch is released. This makes it easy for the user to "back up" to the beginning of the section marked by the beeps.

The Easicorder REC-1 comes in a self-contained desk-top model and a smaller lap-board model which requires the Prentke Romich Du-It controls for operation. The device is powered by rechargeable batteries that provide approximately four hours of operation. Standard cassettes must have the pressure pad removed before they can be used on the Easicorder. Clinical trials will be conducted with several students.

c. *Monitec Emergency Systems.* The Monitec emergency systems are manufactured by RMA Industries, Ltd., Rockville Centre, New York. Three basic systems include a local hookup within the house or between neighbors, a telephone-dialing system that dials directly to emergency personnel (police, fire, ambulance, etc.), and a telephone-dialing system to a central operator.

Monitec I comprises a transmitter and receiver combination with a built-in "sonalert" buzzer. The transmitter is a small battery-operated unit, about the size and weight of a cigarette pack, with a large recessed push button. Combined pulse coding and frequency modulation ensures interference-free operation. The receiver is housed in a black

plastic box that is connected to a standard 110 V a.c. wall outlet through a low-voltage transformer. An alarm sounds when the transmitter button is pressed within 200 ft of the receiver, and shuts off when the receiver is reset by a reset push button.

Monitec II (Fig. 8) employs the same transmitter used for Monitec I, but its receiver is coupled to automatic dialing equipment. A preprogramed tape is used to dial up to five emergency telephone numbers and play a prerecorded message after each number is dialed. The receiver is connected to a standard 110-V a.c. wall outlet through a low-voltage transformer. An emergency power source of rechargeable batteries is available in the event of main power failure.

Monitec III is similar to Monitec II except that a central operator who is on duty at all times is dialed during an emergency, and digital coded messages that identify the user and provide emergency or other pertinent information are sent. The operator then verifies the emergency and calls the appropriate emergency personnel. There is a monthly service charge.

Monitec IV is also similar to Monitec II except that two channels can be activated separately and two types of emergencies (e.g., fire and medical) can be handled simultaneously.

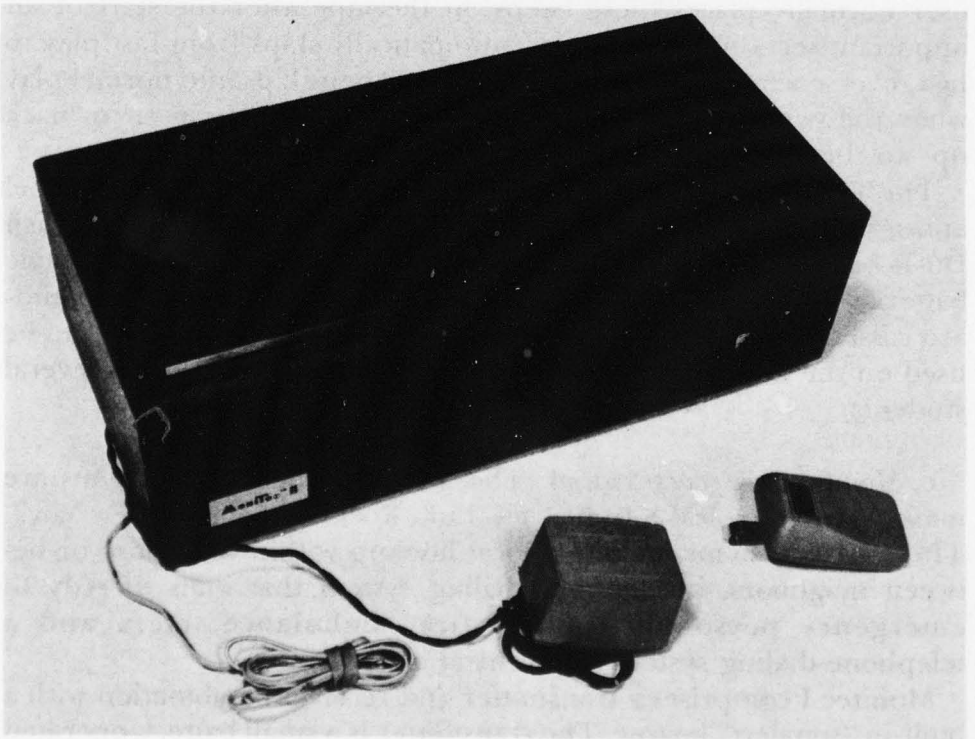


FIGURE 8. — Monitec II emergency system uses a preprogramed tape to automatically dial up to five emergency telephone numbers and play a prerecorded message after each dialing. (The transmitter is the small object at right.)

Laboratory tests on Monitec I and II for function and safety are currently being conducted, and clinical trials are scheduled to begin in early 1979. Testing of Monitec III and IV will begin in the near future.

3. *Mobility Aids*

a. *MED Quadriplegic Wheelchair System.* This powered wheelchair with powered recliner (Fig. 9) is available in many variations from the Medical Equipment Distributors (MED) network of dealers. It is designed to be as flexible as possible so that it can be adapted to suit various user requirements. It uses the Everest & Jennings series 33 powered wheelchair, which will be replaced by the E & J 3-P model in early 1979: the 3-P is similar to the 33. Available controls include a short-throw joystick, dual-axis rocker switch, four-switch slotted control, and single-tube breath control. Gradual acceleration is attained from a starting position; there are two forward speeds. Also included are a MED-i-Cliner powered recliner with head-operated microswitch tubes, troughed armrests that move back as the back reclines, and troughed leg rests that move up as the back reclines. The wheelchair



FIGURE 9.—MED Quadriplegic Wheelchair System is a powered wheelchair with a powered recliner.

system can be tailored to individual needs with both E & J and MED options.

The MED Quadriplegic Wheelchair System is currently being clinically evaluated. It is also being used as a prescription tool by the Clinical Evaluation Service, to allow patients to try various options and controls.

b. *Mobilpodium Mark III.* Designed and constructed under VA contract by the Center For Orthotic Design, Menlo Park, California, this mobile support system (Fig. 10 and 11) allows a paraplegic of up to 160 lb to move about and perform hands-free tasks in various bodily positions, ranging from a squatting position with hips approximately 14 in. above the ground to a fully standing or erect posture. The device can be locked anywhere between the squat and fully-standing positions.

The horizontal drive mechanism of the device is operable at any height and there is a choice of two speeds for horizontal motion. However, only slow speed is recommended for use in the fully standing position, while either fast or slow speed is recommended in the sitting or squatting positions.

The squatting position is designed to allow the occupant to pick up objects from the floor, and the standing position provides leverage so that such tasks as working on a work table, mopping a floor or utilizing standard-height cabinets can be accomplished.

One unit underwent laboratory evaluation at the VAMC, Castle Point, New York. Several recommendations for improvement were sent to the developer. These will be incorporated in the newer models currently being produced by a commercial source. When these are available, an expanded evaluation of the Mobilpodium Mark III will be conducted.

c. *Chin Control Powered Swing Away.* This device (Fig. 12 and 13) manufactured by General Teleoperators, Inc., Downey, Calif., is designed to move the chin control away from the wheelchair occupant when the wheelchair is stationary, or back into position for driving the wheelchair. The device uses a d.c. motor drive that is friction-coupled to a VAPC chin-control structure. It is controlled by a lever-operated, sequentially-actuated microswitch array attached to an adjustable-position bracket. Two units underwent evaluation by the Clinical Evaluation Service (BPR 10-28, pages 103–105). Both were installed on chin-controlled powered wheelchairs already in use at the VAMC, Castle Point, New York. The device was clinically acceptable and a convenience to the wheelchair user; however, recommendations for improvement were sent to the manufacturer before final acceptance.

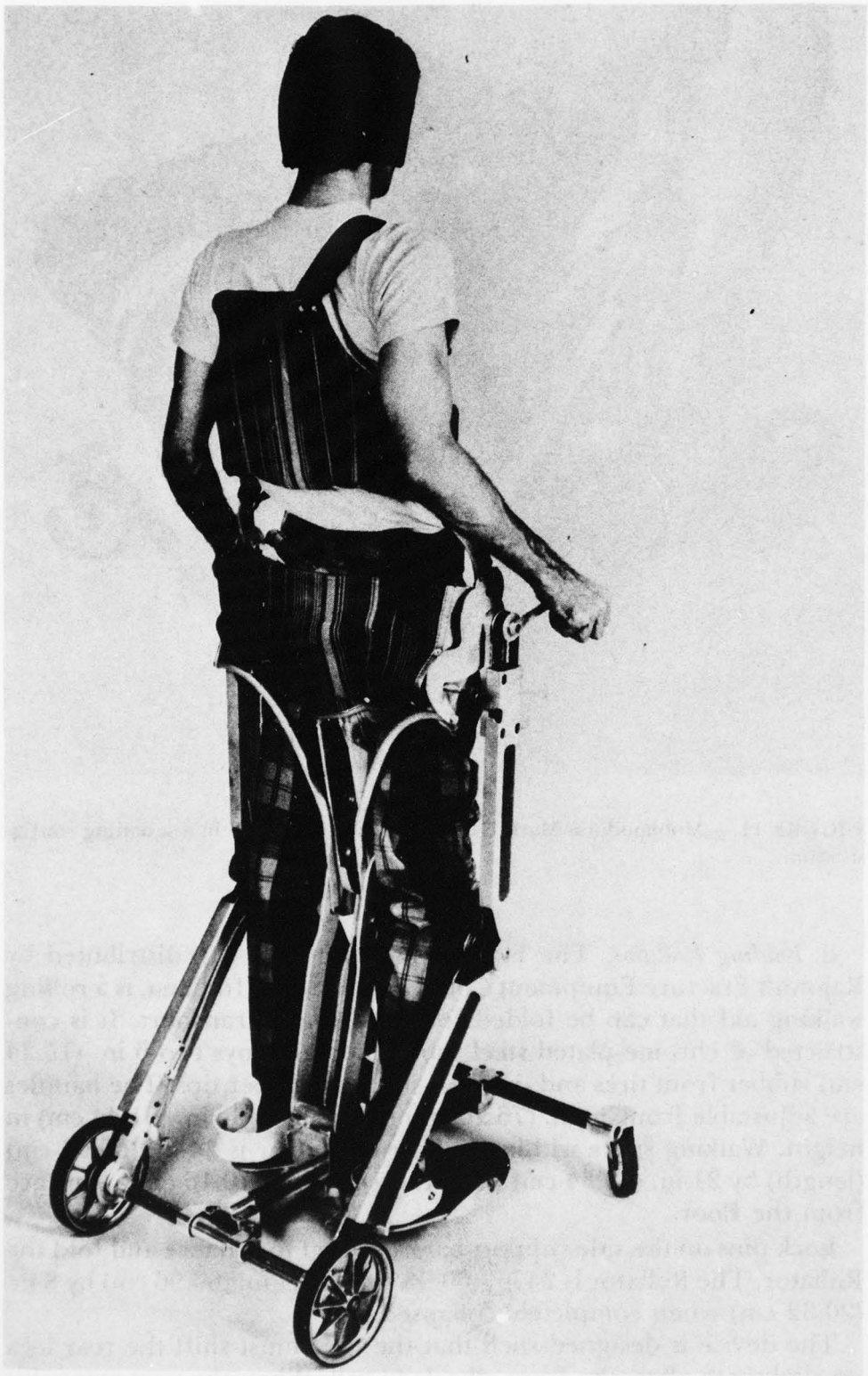


FIGURE 10. — Mobilpodium Mark III; mobile support system in a fully standing configuration.

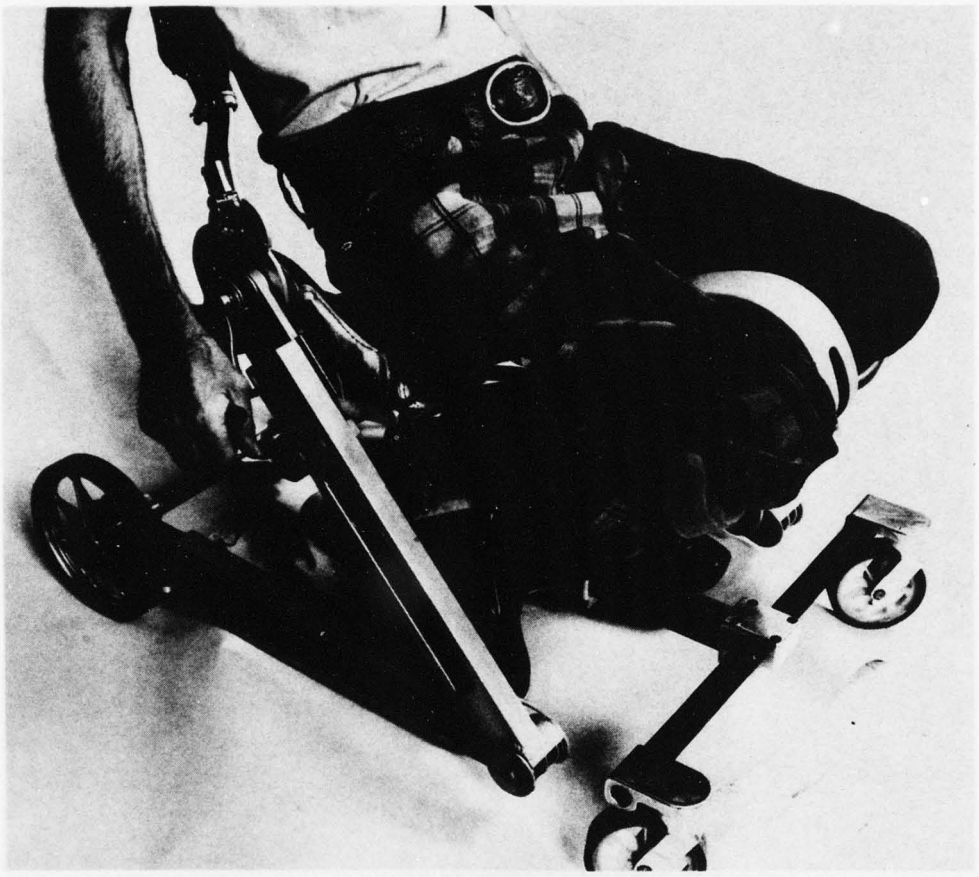


FIGURE 11. — Mobilpodium Mark III; mobile support system in a squatting configuration.

d. *Folding Rollator.* The Folding Rollator (Fig. 14), distributed by Rajowalt Fracture Equipment Company, Atwood, Indiana, is a rolling walking aid that can be folded for storage and transport. It is constructed of chrome-plated steel tubing and employs two 6 in. (15.24 cm) rubber front tires and two non-slip rear rubber tips. The handles are adjustable from 30 in. (76.20 cm) in height to 36 in. (91.44 cm) in height. Walking space within the base perimeter is 24 in. (60.96 cm) (length) by 21 in. (53.34 cm) (width) with a 4 in. (10.16 cm) clearance from the floor.

Lock pins on the side support bars are used to collapse and fold the Rollator. The Rollator is 24 in. (60.96 cm) by 24 in. (60.96 cm) by 8 in. (20.32 cm) when completely collapsed.

The device is designed such that the user must shift the rear legs up slightly to allow the front wheels to roll. When the user stops, his weight on the handle transfers to the two rubber tips at the rear; the rubber tips grip the floor and thereby prevent motion.



FIGURE 12. — Chin Control Powered Swing Away moves chin control away from wheelchair occupant when wheelchair is stationary.

The Folding Rollator is currently being evaluated by the Clinical Evaluation Service.

e. *Supermark Delta.* The Supermark Delta (Fig. 15), distributed by Fracture Equipment Company, Atwood, Indiana, is a folding walking aid with hand brakes and rubber balloon tires. It is constructed of chrome-plated steel tubing and has three 8-in. (20.32-cm) pneumatic tires, one on the front swivel post and two in the rear, in the shape of a



FIGURE 13.—Chin Control Powered Swing Away moves chin control back into position when wheelchair is being driven.

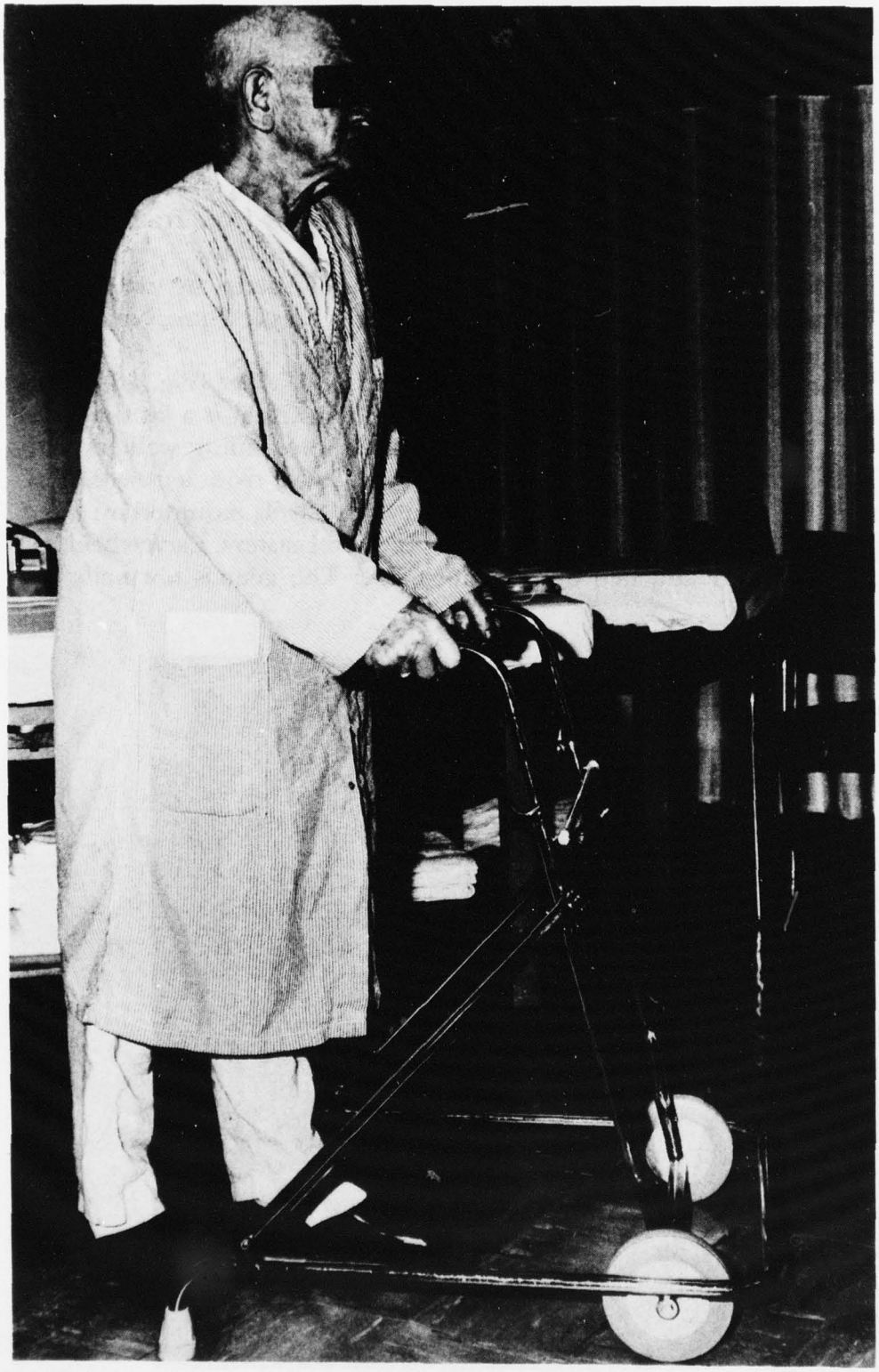


FIGURE 14.—Folding Rollator rolling walking aid. It may be folded for storage and transport.

triangle. Dual, spring-loaded, independently-operated hand brakes stop the device by applying pressure (friction) to the rear tires. The handles are adjustable from 29 in. (73.66 cm) in height to 36 in. (91.44 cm) in height. Walking space within the base perimeter is 19 in. (48.26 cm) from rear wheel to rear wheel. The user folds the device by pulling back on the lever mounted between the upper support bars. The Supermark Delta is 3 in. (7.62 cm) wide at the front frame and 10 in. (25.40 cm) wide across the rear when it is folded.

The Supermark Delta is currently being evaluated by the Clinical Evaluation Service at the VA Medical Center, Castle Point, New York.

f. *Safety Rolling Walker.* The Safety Rolling Walker (Fig. 16), manufactured by Polytechniques, Inc., Cleveland, Ohio, is a kit that converts most non-foldable or foldable walkers to rolling walkers with locking mechanisms. It consists of two adjustable front legs with 5-in. (12.70 cm) diameter rubber tires on plastic wheels mounted on fixed shafts, and two adjustable rear legs with swivel casters. Each wheel has a plastic gear attached on the inner side. The gear is normally en-

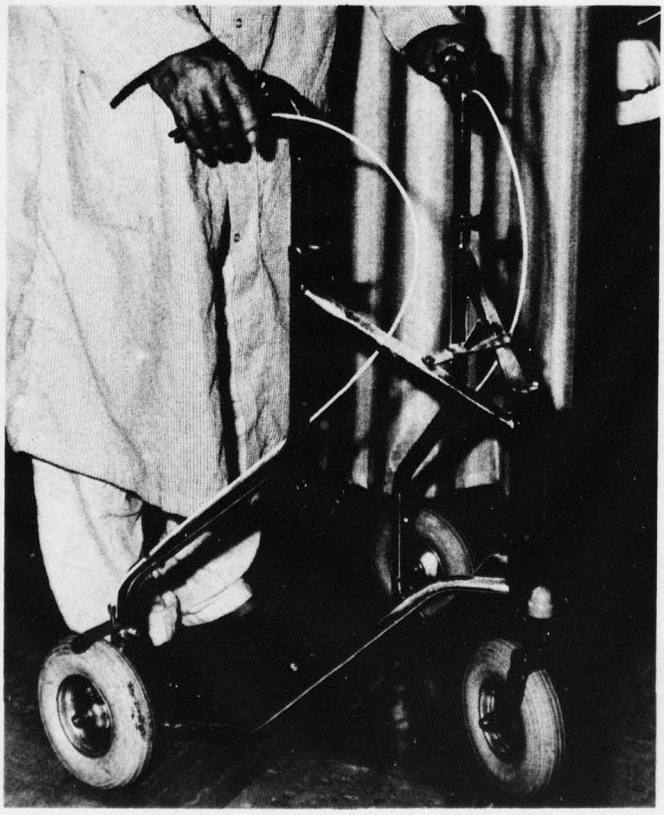


FIGURE 15.—Supermark Delta folding walking aid with hand brakes and rubber balloon tires.

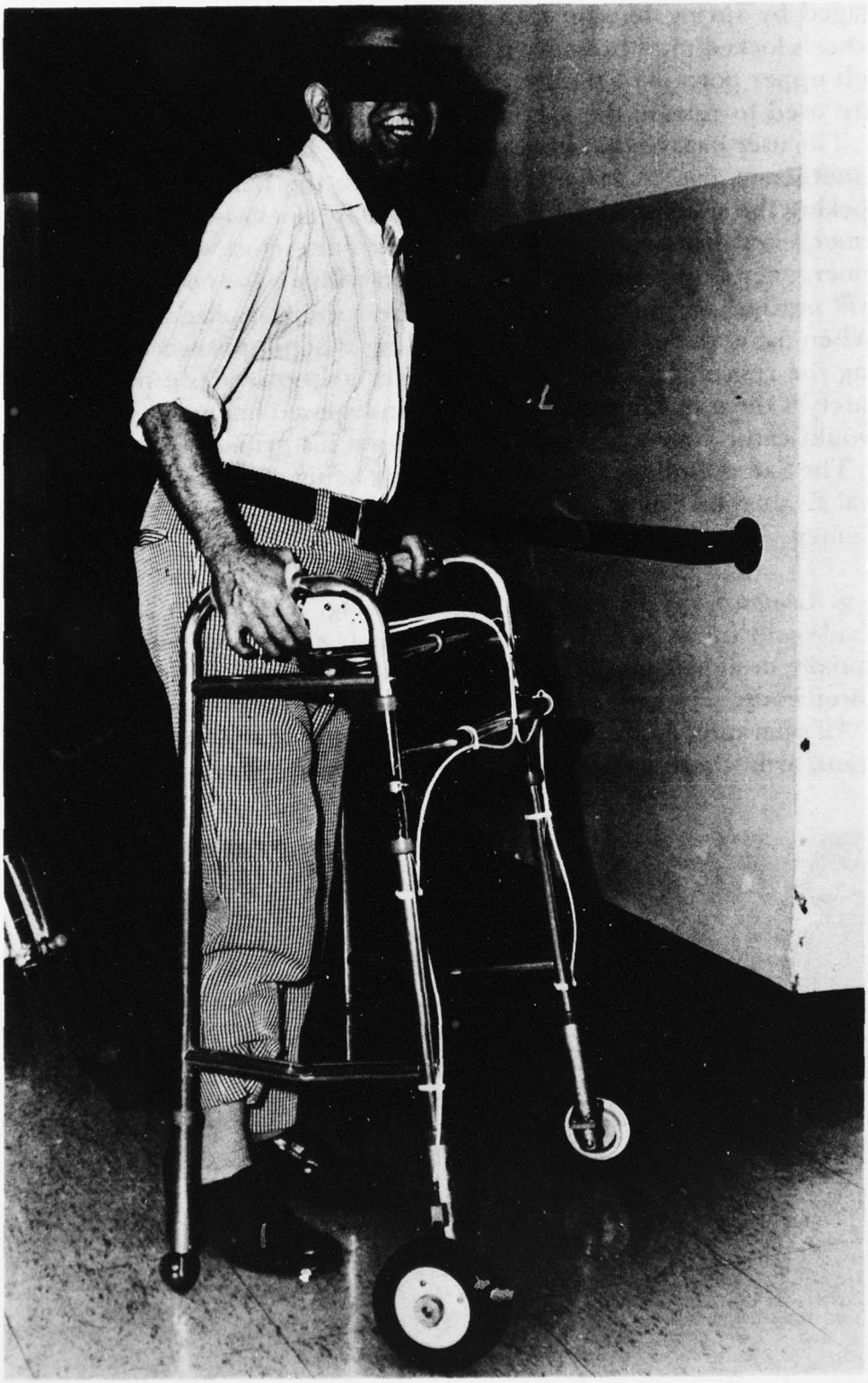


FIGURE 16. — Safety Rolling Walker kit converts most walkers to rolling walkers.

gaged by spring tension to a pivoted gear segment that keeps the wheels locked until pressure is applied to a hand lever on the right or left upper portion of the frame. The two cables attached to this lever are used to release the locking mechanism.

The user has the option of positioning the lever with or without the emergency grip. A large screw just above the hand lever regulates locking the system: adjusting the screw fully clockwise disengages the emergency grip while adjusting it fully counterclockwise engages the emergency grip. The device, when used without the emergency grip, will not lock, no matter how much pressure is applied to the lever. When using the emergency grip, locking is accomplished by overriding the resistance. Using the emergency grip provides a measure of safety if the user faints or is otherwise indisposed unexpectedly, if this would cause him to automatically tighten his grip.

The Safety Rolling Walker is currently being evaluated by the Clinical Evaluation Service, at the Castle Point, New York, VA Medical Center.

g. *Centauri Freewheeler.* This device (Fig. 17), manufactured by Tri-World Industries, Golden, Colorado, is a hand-propelled tricycle initially designed in 1974 for individuals with little or no use of the lower body.

All operating controls on the device are located at the head of the crank arm: these include brake levers, 5-speed gear shifter, parking

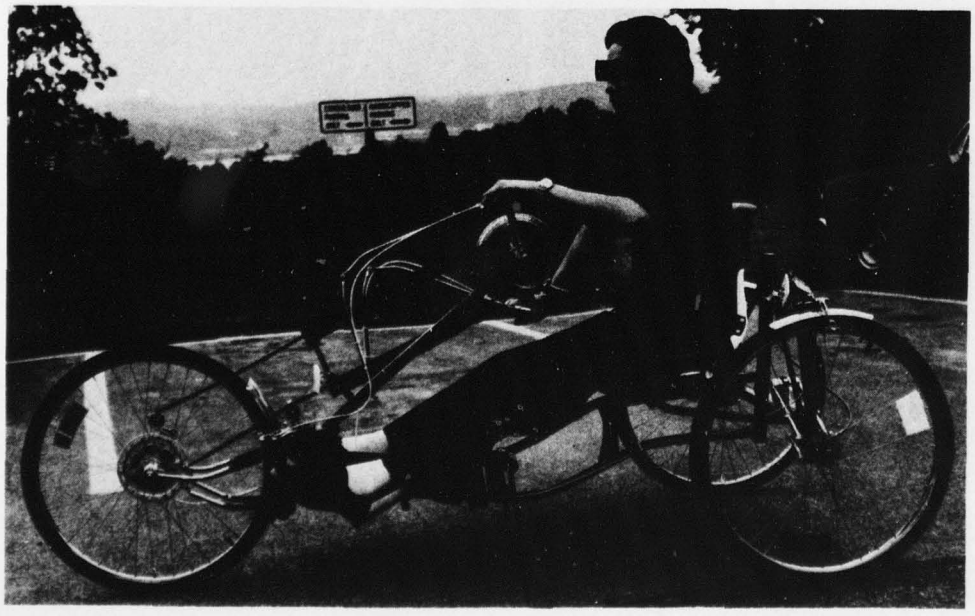


FIGURE 17.—Centauri Freewheeler hand propelled tricycle for individuals with little or no use of lower body.

brake attachment and body guard. The seat and leg rests are adjustable to achieve the proper crank location relative to the body. Four sets of Velcro safety straps secure the body in position: the two upper sets secure the chest and waist, the two lower sets the legs and feet.

Forward motion is attained by simultaneously pushing and pulling opposite handles. Shifting of gears is accomplished while the device is in motion. To reverse direction, the user pushes the rear wheels backwards by hand much like a manual wheelchair. Two side-pull caliper brakes are located on the front and right rear wheels. The manufacturer claims that the device will stop within 15 ft from a speed of 15 mi/h (which meets the standards of the Consumer Products Safety Commission) and recommends a top speed of 20 mi/h (32 km/h).

One Centauri Freewheeler is currently being evaluated at the VAMC, Castle Point, New York; another is being evaluated by a veteran outpatient on his farm.

h. *Independence Walker.* This 22 in. wide by 23 in. deep powered ambulator (Fig. 18), manufactured by Falcon R & D Corp., Denver, Colorado, is propelled by a single motor-chain assembly and powered by a 12-V battery, and employs an automatic battery-charger rated at 12 V, 6 A.

The user must enter from the front and turn himself around to operate the driving mechanism. He is supported by a waist-high locking belt and two padded cushions, one at knee level, the other at approximately the base of the spine.

Driving is accomplished by means of a forward-mounted tiller handle incorporating a toggle switch which directs power to the motor and a linkage to the rear wheels for steering control.

The Independence Walker was evaluated by the Clinical Evaluation Service at the VA Medical Center, Castle Point, New York, and the VA Extended Care Center at St. Albans, New York. It was reviewed at the Medical Center, New York, New York.

i. *Moto-Stand.* This powered ambulator (Fig. 19), developed by Ausmus Manufacturing Co., Independence, Missouri (BPR 10-28, page 114), offers a 3-wheel support base with the single rear wheel providing the power. Evaluation was conducted by the Clinical Evaluation Service at the VAMC, Castle Point, New York and the St. Albans, New York, Extended Care Center, and consistent clinical experiences were observed. The results and recommendations for improvement were sent to the manufacturer.

j. *VAPC Powered Ambulator.* The VAPC Powered Ambulator (Fig.



FIGURE 18. Independence Walker powered ambulator propelled by a single motor-chain assembly.

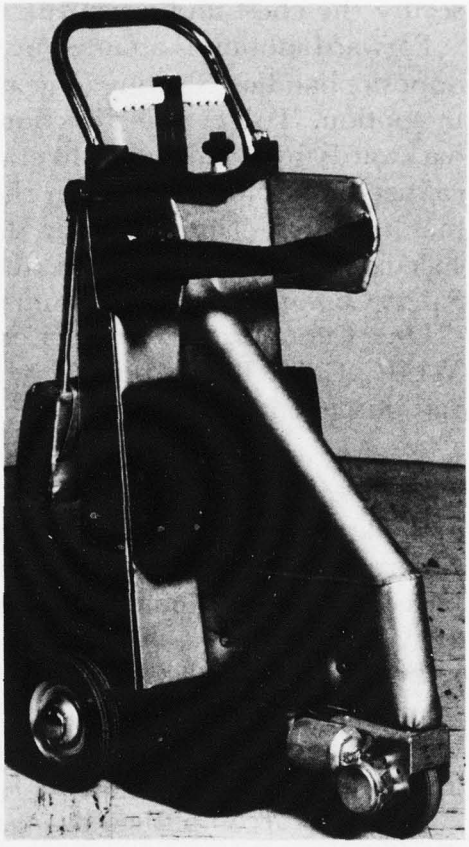


FIGURE 19. — Moto-Stand powered ambulator with 3-wheel support base.

20) is, primarily, an evaluation tool to determine the potential clinical benefits of powered mobile platforms that maintain their occupants in standing positions. (BPR 10-28, pages 113-114.)

The original model combines the basic chassis and support platform of the Jouk Ambulator, but it is powered by a pair of A-BEC powered wheelchair motors controlled by a 24-V Motorette proportional controller. Maximum speed is approximately 3 mi/h with a 180-lb occupant on level ground.

The device is used by residents and outpatients at the St. Albans, New York, Extended Care Center.

In general, the three or four subjects who routinely use the ambulator experience a reduction in lower-limb muscle spasticity. Multiple sclerosis patients who use this device do not require long leg braces. One outpatient finds that his urinary bladder retention has

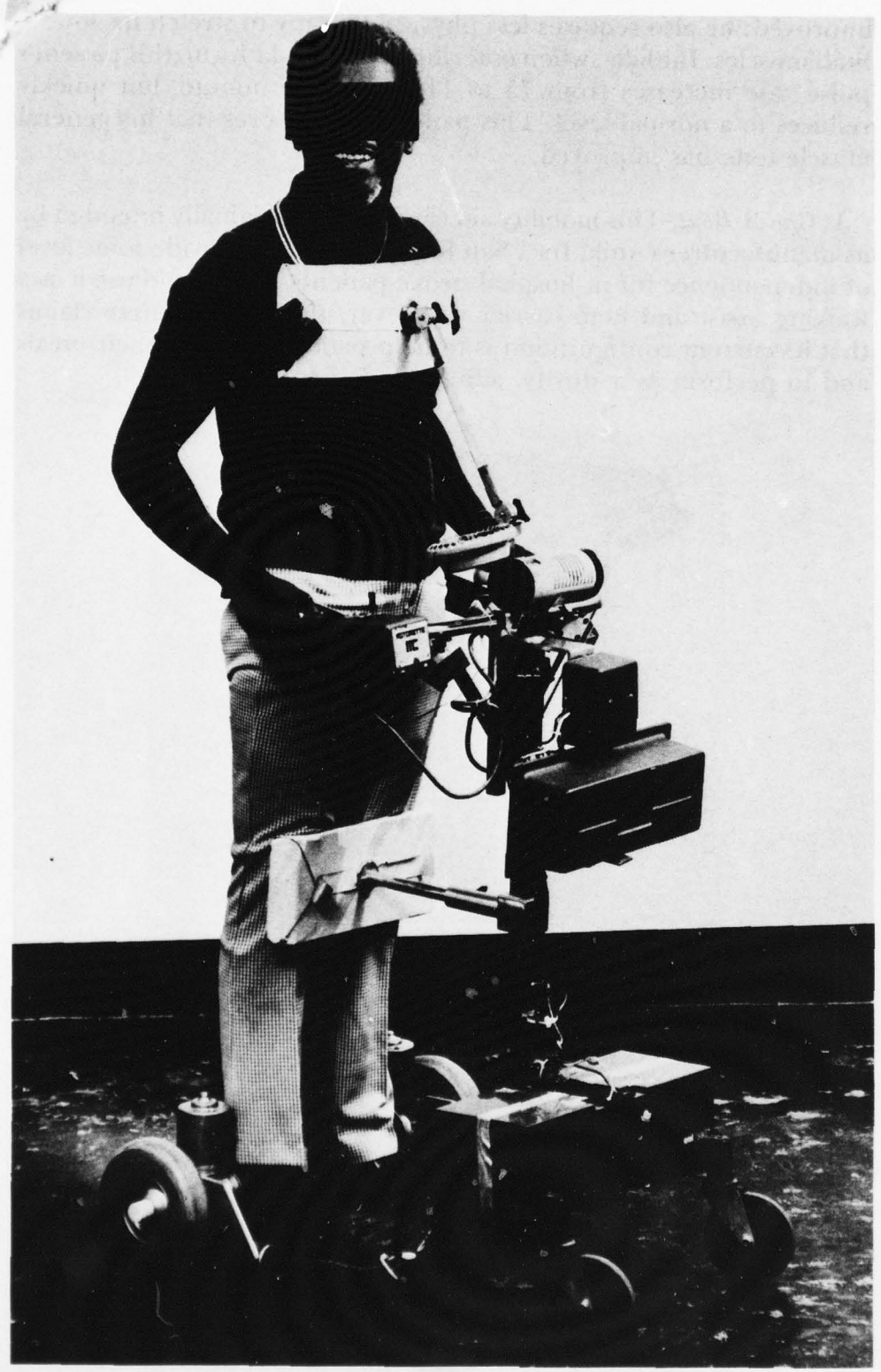


FIGURE 20. — VAPC powered ambulator evaluation tool.

improved; he also requires less physical therapy to stretch his lower-limb muscles. Initially, when entering onto the platform, this patient's pulse rate increases from 75 to 110 beats per minute, but quickly reduces to a normal level. This patient also believes that his general muscle tone has improved.

k. *Gad-A-Bout.* This mobility aid (Fig. 21) was originally intended by its manufacturer (Anik, Inc., San Rafael, Calif.) to provide some level of independence for in-hospital stroke patients, who would use it as a walking assist and item carrier. However, the manufacturer claims that its current configuration is to help patients manage their meals and to perform as a sturdy, adjustable-height walker.

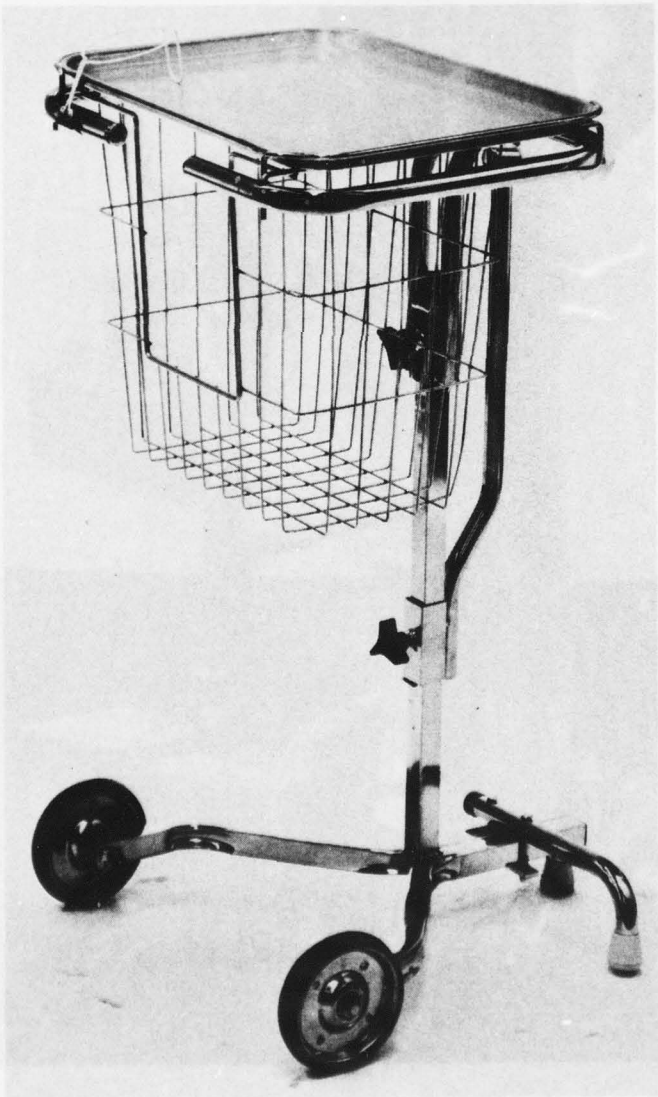


FIGURE 21. — Gad-A-Bout personal mobility aid.

AD-A070 587 VETERANS ADMINISTRATION WASHINGTON DC DEPT OF MEDICI--ETC F/G 5/2
BULLETIN OF PROSTHETICS RESEARCH. SPRING 1979,(U)
1979 E F MURPHY
UNCLASSIFIED BPR-10-31 NL

3 OF 6
AD
A070587



The Gad-A-Bout offers a 3-point support; two points are small wheels and the third is a rubber tip. Overall weight is approximately 10 lb and hand-grip height is adjustable from 24 in. to 40 in. above the floor. The top surface of the tray and basket carrier is adjustable from 29 in. to 36 in. above the floor.

According to the manufacturer, the Gad-A-Bout should be used by independent ambulators, with or without an assistive device, but is contraindicated for those with ataxia. If the Gad-A-Bout is used for weightbearing and/or balance, the support force must be applied vertically to maximize stability. It is not intended to assist in climbing stairs.

The device will be clinically evaluated when a suitable number of patients, willing and able to use this device, are found.

4. *Body Supports*

a. *Nitto "No Sore" Cushion Pad.* This gel wheelchair cushion (Fig.22), developed by Nitto Company, Japan, and imported to this country by Nitto Dinko America, Inc., Lake Success, New York, weighs approximately 10 lb and is 15.5 in. long and 14.5 in. wide. The Nitto "No Sore" Cushion is lighter than some comparable gel cushions available in this country, but its dimensions are smaller and it does not completely cover the seat of an adult-size wheelchair. The cushion was tested by two subjects at the VA Medical Center, Castle Point, New York. While it was found to be comparable to gel cushions they had previously used, both subjects indicated that the Nitto pad was lighter to maneuver for transferring. Nitto anticipates marketing the cushion at a much lower price than its comparable gel cushion manufactured in the United States.

b. *RoHo Dry Flotation Cushion.* This cushion (Fig. 23), manufactured by Research and Development, Inc., East St. Louis, Illinois, uses air to support the patient's body uniformly and comfortably and thereby



FIGURE 22. — Nitto "No Sore" Cushion Pad.

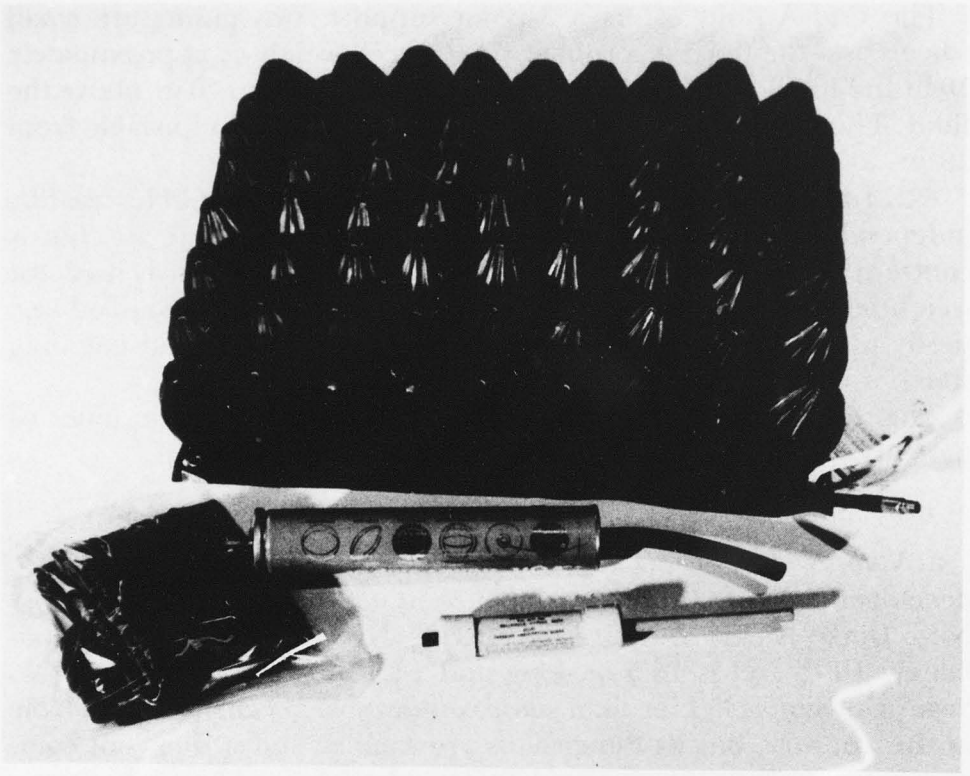


FIGURE 23. — RoHo Dry Flotation Cushion minimizes, prevents or heals pressure sores. Inflating device and pressure verification gage are shown in foreground.

minimize, prevent or assist in the healing of pressure sores (BPR 10-28, pages 117-118).

The *RoHo* was found to be useful for patients with hard-to-heal pressure sores, those with difficulties in sitting due to such conditions as hip disarticulation, perineal pressure, or those experiencing unsatisfactory results from other types of cushions. Clinical acceptance of this cushion is evidenced by the fact that over 50 cushions were used by patients at the VA Medical Center, Castle Point, New York, since the onset of the evaluation.

c. Pneumatic Lifter Seat. This portable vinyl-covered lifter (Fig. 24 and 25), distributed by the Rojowalt Company, Inc., Atwood, Indiana, helps raise the disabled individual from a sitting to a standing position. The device weighs 10.5 lb (4.76 kg) and measures 16.5 in. (41.91 cm) long by 16.5 in. (41.91 cm) wide by 3.5 in. (8.89 cm) high. Its foam-padded seat is attached to a chromium-plated steel tubing base with two pneumatic cylinders. The pneumatic cylinder brackets are adjustable (three positions) for patients of differing weights.

The device is currently being clinically evaluated by the Clinical Evaluation Service at the VA Medical Center, Castle Point, New York.



FIGURE 24. — Pneumatic Lifter Seat helps raise disabled individual from a sitting to a standing position.

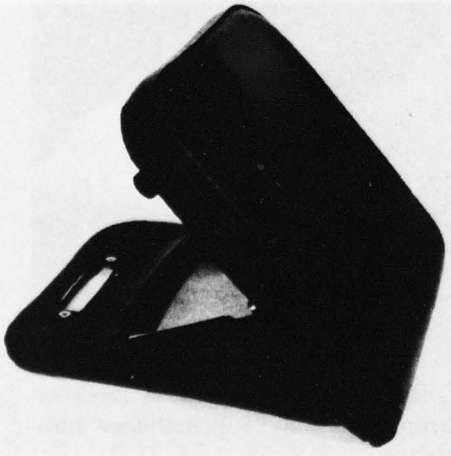


FIGURE 25. — Pneumatic Lifter Seat

d. *Babette Bath.* The Babette Bath (Fig. 26 and 27), manufactured by Babette Industries, New York, N.Y., is a modular bathroom assembly that incorporates a sink, a foldaway bathtub, and a hand shower. The use of a soft bathliner adds to its safety. The device will be reviewed with patients having various physical handicaps, by the Clinical Evaluation Service, VA Medical Center, Castle Point, New York to determine indications for use. It will then be evaluated in the home of an outpatient.

5. *Lifts And Transfer Aids*

a. *Mann's E-Z Way Chair Lift.* This semi-automatic wheelchair loader (Fig. 28), manufactured by the M.E.W. Company, Tulsa, Oklahoma, is designed to maneuver and position a collapsed manual wheelchair easily into the trunk of a car or the cargo area of a station wagon or van, while decreasing the chances of the user incurring a back injury. The device consists of a boom assembly and electric winch, and a wheelchair holding bracket. The device underwent laboratory tests and clinical trials by the Clinical Evaluation Service at the VA Medical Center, Castle Point, New York (BPR 10-28 pages 124–125). It was found to be functionally useful and effective for wives and attendants of wheelchair users in storing wheelchairs in sedan trunks. Recommendations for improvement were sent to the manufacturer before final acceptance.

b. *Wilson Transporter.* Originally designed by Mr. Riley Wilson, Colorado Springs, Colorado, and later developed and marketed by Shyler

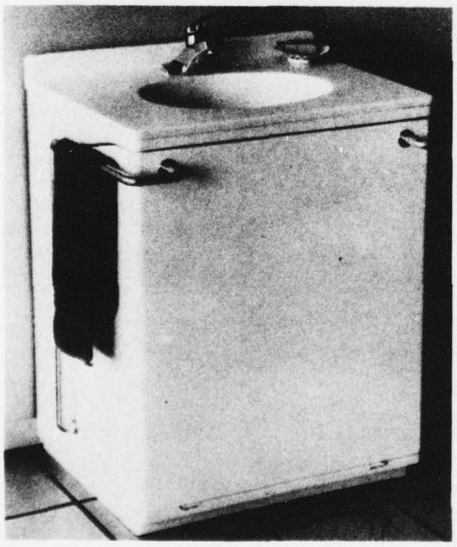


FIGURE 26. — Babette Bath modular bathroom assembly in foldaway configuration.

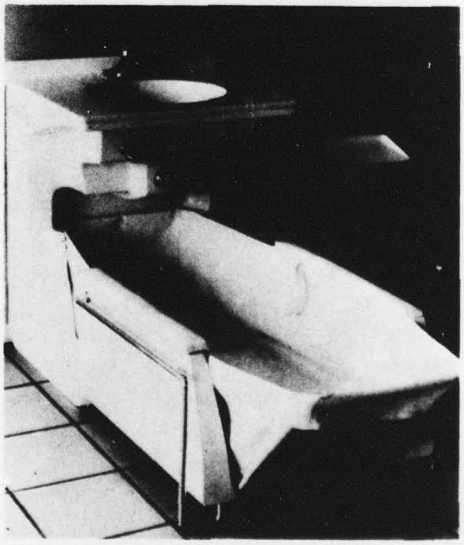


FIGURE 27. — Babette Bath modular bathroom assembly; soft bathliner adds safety.



FIGURE 28. — Mann's E-Z Way Chair Lift semi-automatic wheelchair loader.

Corp., Colorado Springs, this 65-lb (29.48 kg) device (Fig. 29) is used to help transfer and transport the disabled. The base of the transporter is 20 in. (50.8 cm) wide at the rear, 8 in. (20.32 cm) wide at the front, 36 in. (91.44 cm) long from front to rear, and 5 in. (12.70 cm) high from the floor. The two rear swivel casters are 3.5 in. (8.89 cm) in diameter and the front swivel caster is 5 in. (12.70 cm) in diameter. The front caster and one of the rear casters include a lock.

The patient's handle bars are 37 in. (93.98 cm) from the floor and the attendant's handle bars are 31 in. (78.74 cm) from the floor. The hydraulic lift, located 15 in. (38.10 cm) from the front of the base, has a lifting capacity of 300 lb (136.08 kg.). The seat, which is constructed of plastic fiber with a smooth top surface, is 16 in. (40.64 cm) long by 10 in. (25.40 cm) wide; it can be raised to a height of 32 in. (81.28 cm) from the floor and lowered to 16 in. (40.64 cm) from the floor. The seat can be easily replaced by an optional commode seat. Safety straps are included for patient safety.

The Wilson Transporter is currently being evaluated by the Clinical Evaluation Service at the VA Medical Center, Castle Point, New York to determine indications for use.

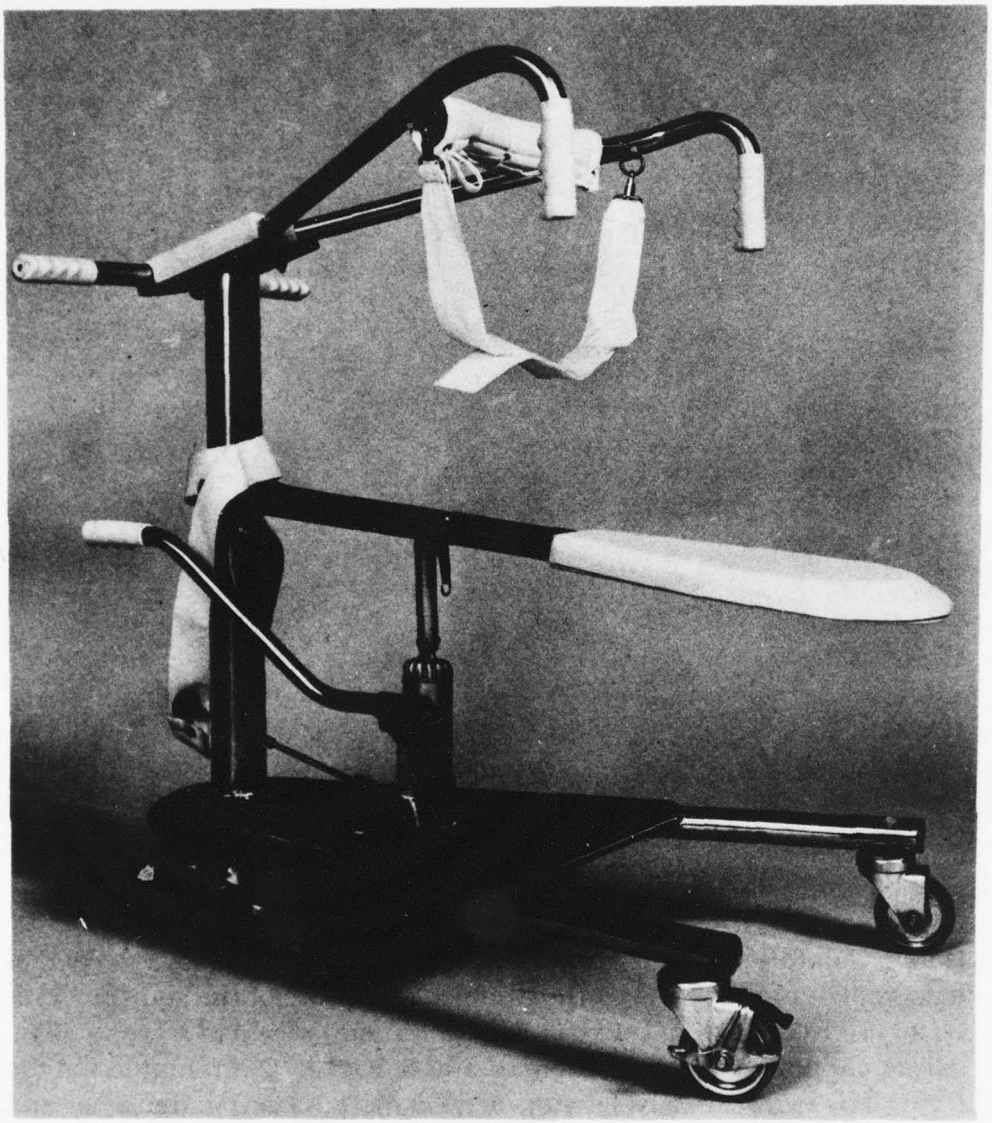


FIGURE 29. — Wilson Transporter helps to transfer and transport the disabled.

c. *Garaventa Wheelchair Elevator.* This device (Fig. 30), designed in Switzerland and currently available in the United States from Garaventa Limited, Langley, British Columbia, Canada, attempts to fill the gap left by wheelchair elevators presently on the market in the United States: the Garaventa Wheelchair Elevator can be adjusted to accomodate simple or complex bends and irregularities found in narrow staircases, spiral staircases, and staircases with sharp turns.

The wheelchair platform is supported on two parallel tubes attached to a steel haul cable that is accessible through a narrow slot cut along the underside of the upper tube. These tubes are bent in three dimensions to allow the path of the elevator to be tailored to a wide variety of

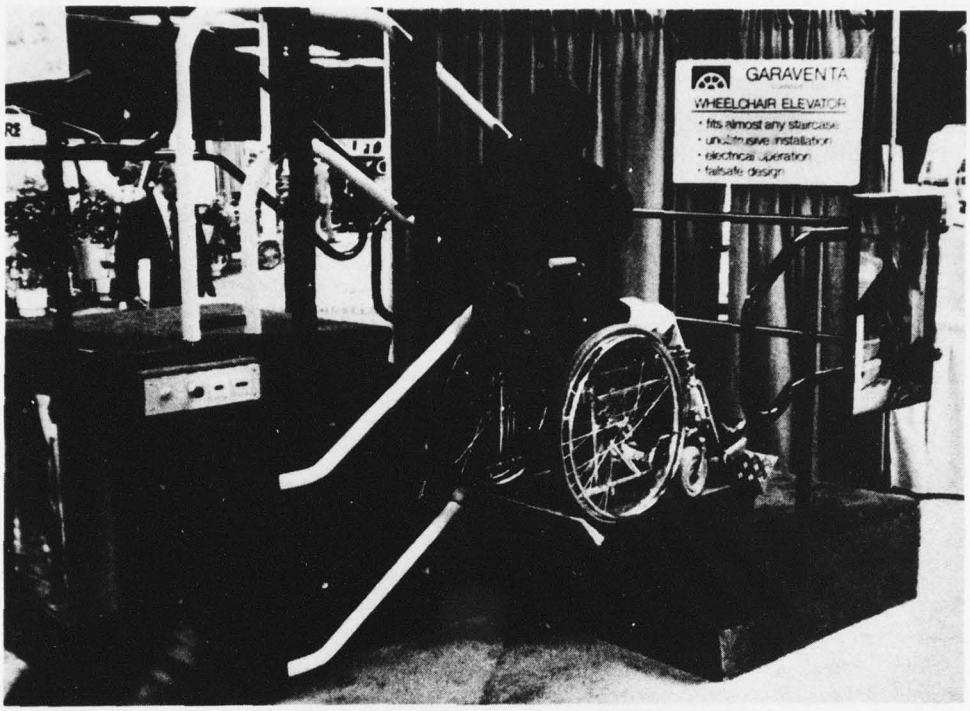


FIGURE 30. — Garaventa Wheelchair Elevator attempts to fill gap left by currently available wheelchair elevators.

variously shaped staircases of differing sizes.

This type of elevator system may be useful in a raised or high ranch home in that it may provide access to both upstairs and downstairs without interfering with the use of the door at mid-landing.

The Garaventa Wheelchair Elevator will be evaluated through our home-care program when a suitable candidate is found.

d. *Tuba-Chair.* This aid (Fig. 31 and 32), manufactured in Western Europe and distributed in the United States by Medical Equipment Distributors (MED), Inc., is claimed by the manufacturer to be a reasonably convenient way to transfer a severely physically disabled person from a bed to a sitting position. It employs a hydraulically operated mechanism, which raises or lowers the seat height of the Tuba-Chair between 19 in. and 24 in. from the floor. As the seat height is raised, the chair back is simultaneously lowered and the leg rest is elevated so that the device assumes a conventional stretcher-like configuration. The back and leg rest may be manually adjusted only when the seat is in its lowest position.

The hydraulic mechanism may be controlled by foot pedals located on both sides of the chair. A support adjustment rod on the back of the chair permits the back to be instantly lowered if the occupant begins to experience a blackout or other emergency. The front edge of the seat

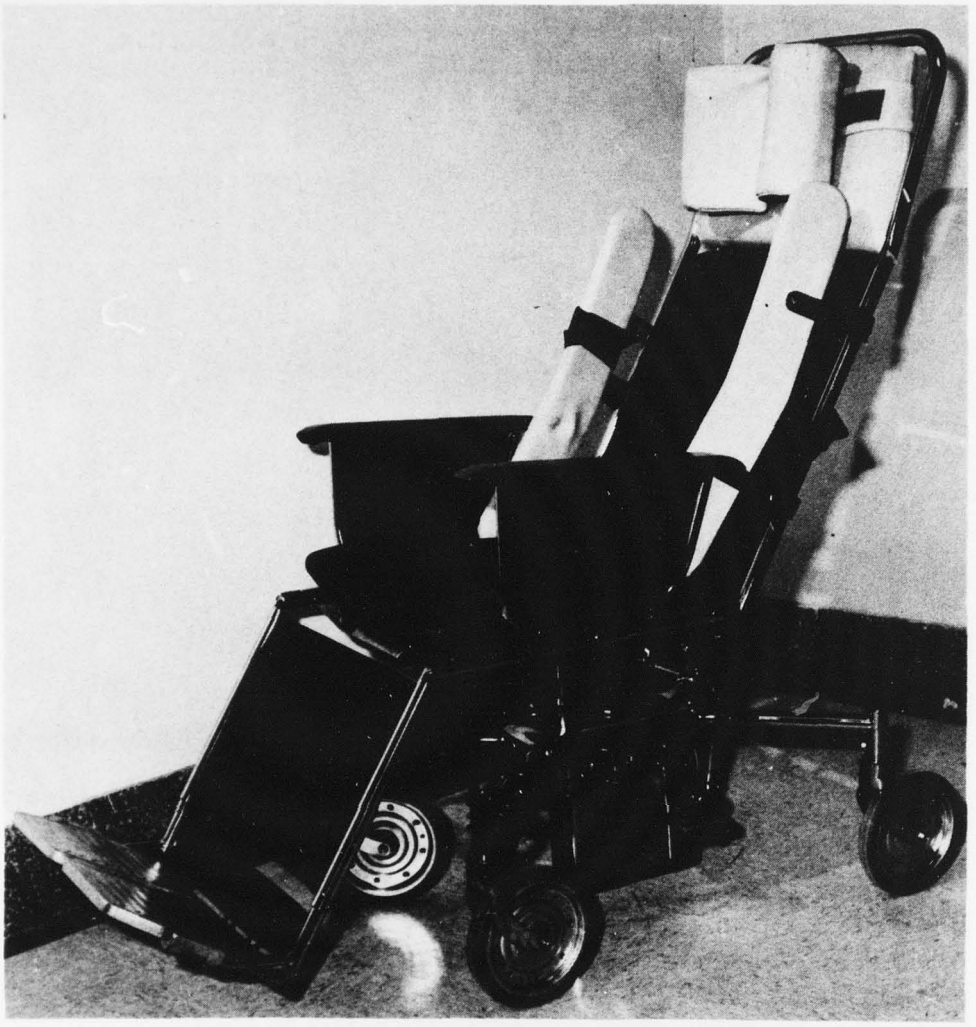


FIGURE 31. — Tuba-Chair in geriatric wheelchair configuration.

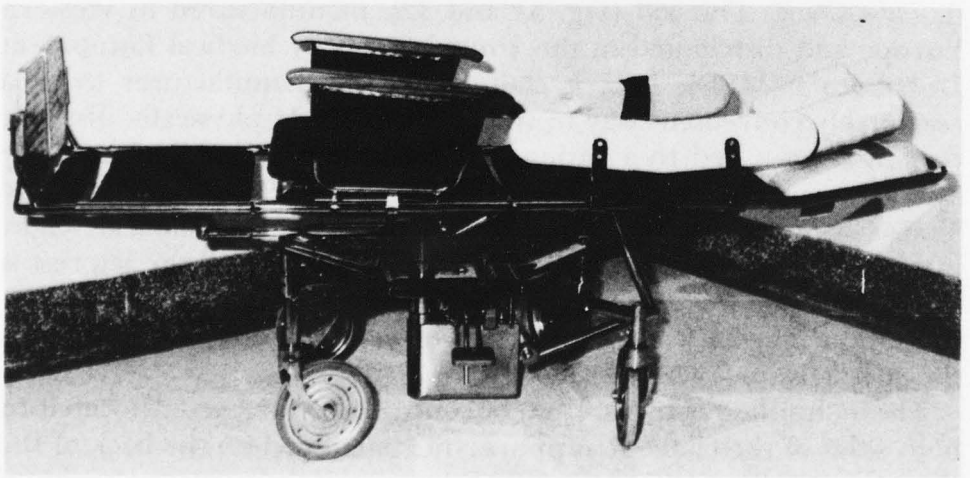


FIGURE 32. — Tuba-Chair in stretcher configuration.

may be tilted up, i.e., tilted down toward the rear of the chair, to prevent the occupant from sliding forward and to provide additional hip flexion.

The Tuba-Chair, if equipped with small wheels, assumes a geriatric chair configuration. However, 22 in. diameter pneumatic wheels may be installed in the front, as an option, to make the chair resemble a conventional wheelchair.

Offset, removable, reversible armrests are available with safety locking features which permit a limited adjustment (approximately 5 in.) in the mediolateral plane for different patient widths. These armrests may also be shifted toward the front or rear, depending upon patient requirements.

When equipped as a geriatric chair, the chair's four small wheels are free to swivel, but the front wheels may be locked to facilitate steering by an attendant. The front wheels are equipped with brakes.

The Tuba-Chair may be fitted with optional accessories such as an adjustable neck support to secure an occupant's head in a more comfortable position. Pads may be adjusted from side to side and for height. Side supports secure the occupant in an upright or prone position. A worktable attachment may be added for working or eating —or simply to maintain the occupant in a more secure position. The footrests are adjustable for different patient heights and do not require special tools for adjustment.

Clinical evaluation of the Tuba-Chair is nearing completion at the St. Albans, New York, VA Extended Care Center. Results thus far are satisfactory.

e. *Stretcher Chair.* This device (Fig. 33 and 34), similar to the Tuba-Chair already described, is manufactured by Everest & Jennings, Inc., Los Angeles, California. It is available only in a geriatric chair configuration. In contrast to the Tuba-Chair, the Stretcher Chair uses a mechanism to select different configurations.

Seat height is adjustable by a side-mounted crank to facilitate patient transfer between the patient's bed and the Stretcher Chair. Back and leg rests are independently controlled so that the occupant may be oriented in a seated position, a fully reclining position, or any combination thereof. The armrests may be folded down on the lateral aspects of the chair.

The four wheels are all approximately 5 in. in diameter and free to swivel. The rear swivel (caster) wheels incorporate independent, foot-operated locks to preclude motion. Both front caster wheel assemblies may also be locked into either a forward or turning configuration (0 or 90 deg) to attain a swivel action by pivoting the rear section about the front end, or to completely lock the entire unit when the rear wheel locks are employed.



FIGURE 33. — Stretcher Chair (E&J) in geriatric wheelchair configuration, upright position.

Back, seat and leg paddings have Velcro fasteners and may be readily removed for washing. The headrest can be relocated or repositioned by means of its Velcro fasteners.

This device is undergoing evaluation at the VA Extended Care Center St. Albans, New York. Thus far, clinical findings are satisfactory.

f. *Stretchair.* The Stretchair (Fig. 35 and 36), manufactured by Mobilizer Medical Products, Inc., Mt. Vernon, New York, is available in two models: one model assumes either a stretcher-like configuration or a typical geriatric-chair-like configuration; the other model assumes a stretcher-like configuration and a standard-wheelchair-like configuration. A "U"-shaped handle near the top, behind the high backrest,

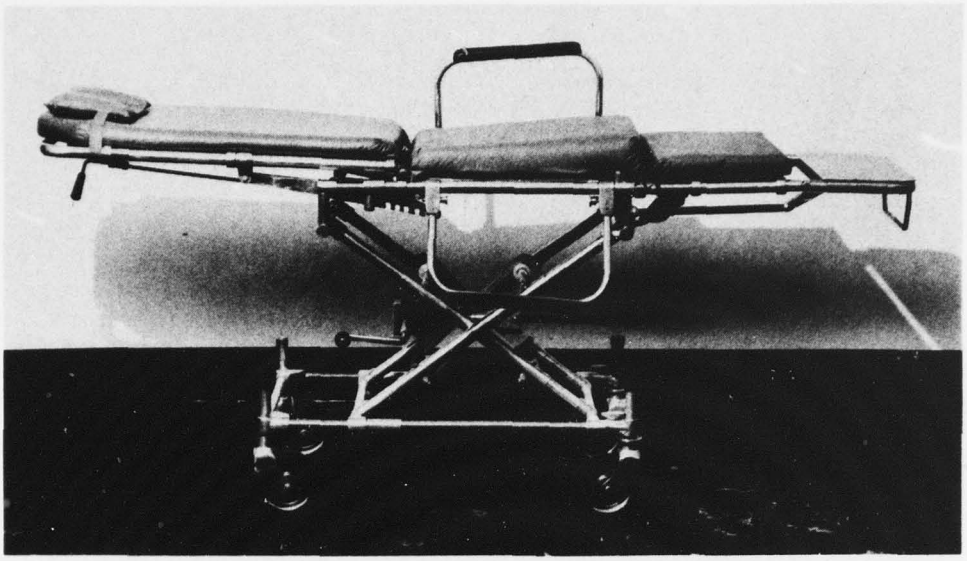


FIGURE 34. — Stretcher Chair (E&J) in stretcher configuration, reclining position.

is pulled to disengage the adjustment mechanism. Back and leg rests are not independently adjustable and the height of the seat and back in the stretcher configuration is not adjustable. The footrest can be pivoted about its end supports to be flat in the stretcher configuration or to provide a footrest in the chair configuration.

The front wheels are fixed but the rear wheels are free to swivel. The rear wheels are equipped with brakes that can effectively immobilize the Stretchair. Removable armrests are height-adjustable.

One unit has been successfully used to manage a 20-year-old veteran with a sub-dural hematoma at the VA Extended Care Center, New York.

Another unit is also being successfully used with a severe multiple sclerosis quadriplegic patient who has tight knee and hip musculature making him unable to sit in a regular wheelchair. The Stretchair is most effective for this patient in a partially folded configuration.

6. *Miscellaneous*

a. *Pulsemeter.* The Pulsemeter, Model 2D16 (Fig. 37), manufactured by San-Ei Instrument Co., Ltd., Tokyo, Japan, is a battery operated pulse-rate indicator that measures 6.5 in. by 3.5 in. by 2.0 in. and weighs approximately 19 oz. This instrument is the most portable of its kind evaluated to date.

Typically, a light incorporated in the finger sensor is diffused through the fingertip to illuminate a cadmium-sulphide photocell. The light is interrupted by the pulsatile blood flow, causing the electrical resistance of the photocell to vary with each pulsation. The signal is conditioned and amplified by transistor circuitry within the instrument

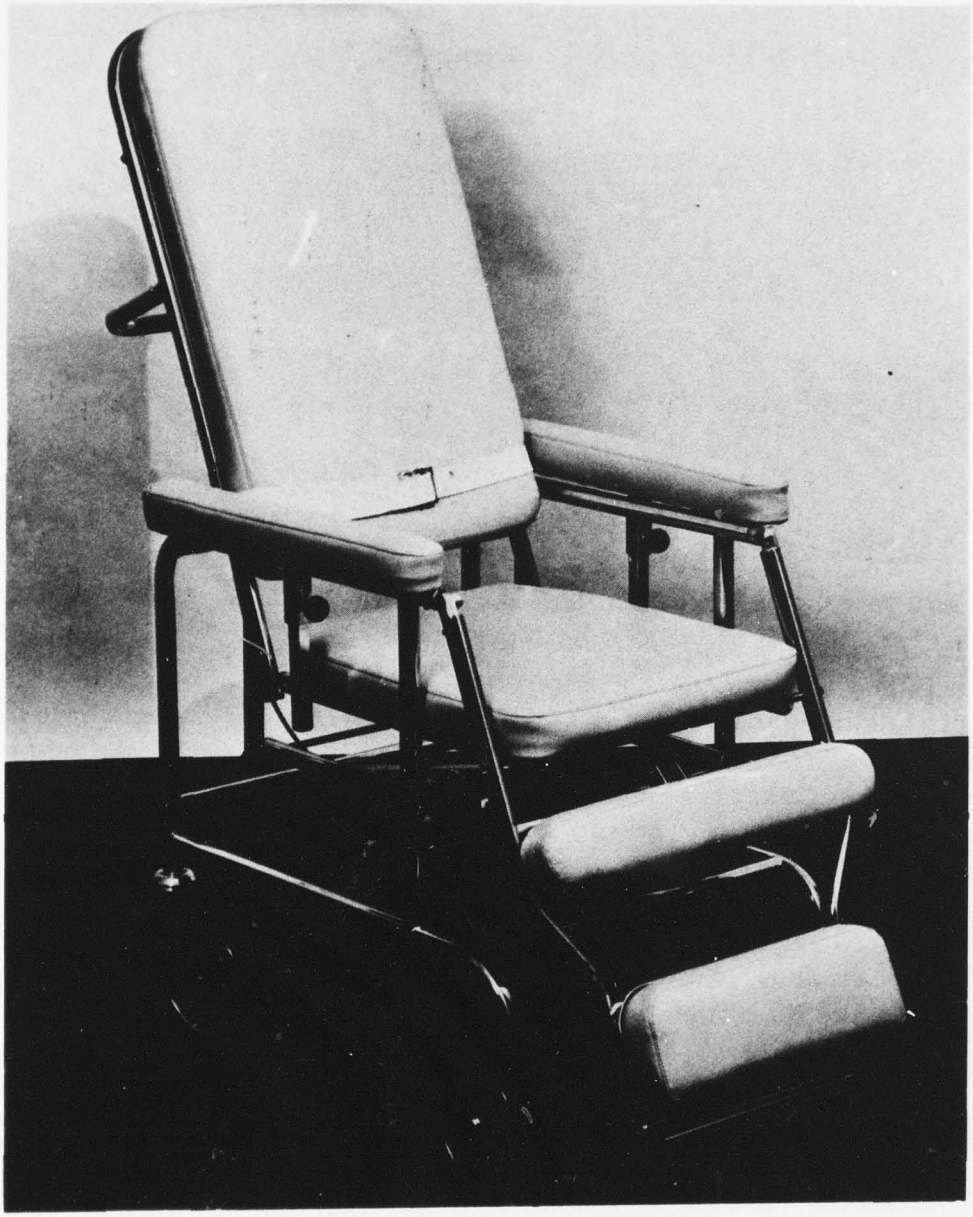


FIGURE 35.—Stretchair (Mobilizer Medical Products) in geriatric wheelchair configuration, upright position.

and displayed in three different fashions. A meter calibrated in beats-per-minute, with a working range of 30 bpm to 200 bpm, indicates a pulse rate that has been averaged typically over the most recent several beats. The remaining two displays are an audible tone "beeper" and a built-in "flash" indicator; these are triggered each time a pulse is sensed.

Reports received from the evaluation conducted by the Corrective

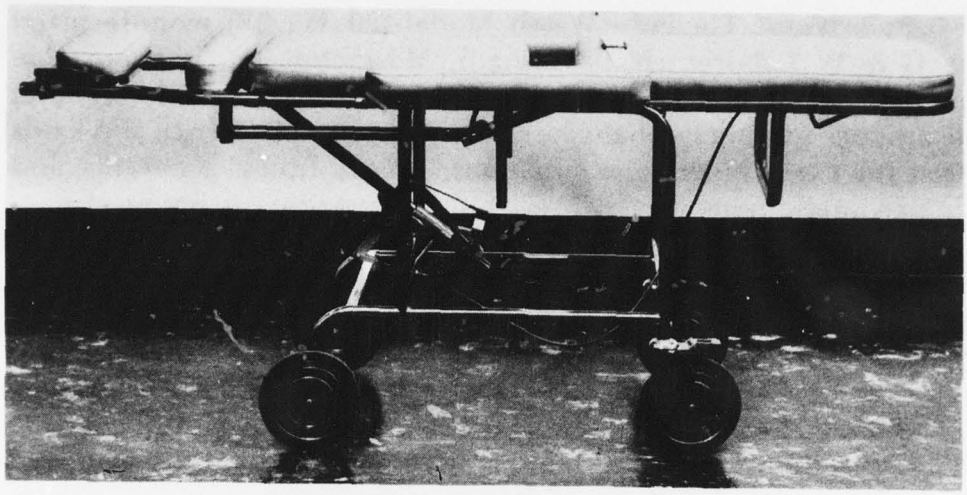


FIGURE 36. — Stretchair (Mobilizer Medical Products) in stretcher configuration, reclined position.



FIGURE 37.—Pulsemeter Model 2D16 showing finger sensor, optional ear lobe sensor, battery charger and mounting bracket.

Therapy department at the VA Extended Care Center, St. Albans, New York, resulted in a recommendation that this device be approved for use in VA health care installations.

b. *Pulse Watch.* The Pulse Watch, Model 420 (Fig. 38), manufactured by G & W Laboratories, Waltham, Massachusetts, is a portable battery-operated heart-rate monitor that is ideally suited for general health care in clinics, rehabilitation centers, etc. The device also lends itself for use in emergency situations, athletic fitness programs, and similar applications where direct pulse monitoring is required.

The Pulse Watch utilizes a photoelectric sensor that clips onto the finger. Pulse rate is displayed visually by means of a large meter on the face of the instrument, in addition to an LED (light emitter diode) that lights each time a heart beat is sensed. An audible signal from an internal speaker (a short tone per pulse) is available when desired.

Calibrated in beats-per-minute, the range displayed is 40 bpm to 200 bpm, with the reading indicating a pulse rate that has been averaged typically over the most recent five to seven beats.

The device was evaluated by the Corrective Therapy department at the VA Extended Care Center, St. Albans, New York. Ease of use along with accurate determination of pulse rate has led to a recommendation that approval be given to use this device in VA health care installations.

c. *Touch-Lite.* The Touch-Lite (Fig. 39) is designed for physically disabled housebound veterans who need special appliances that need

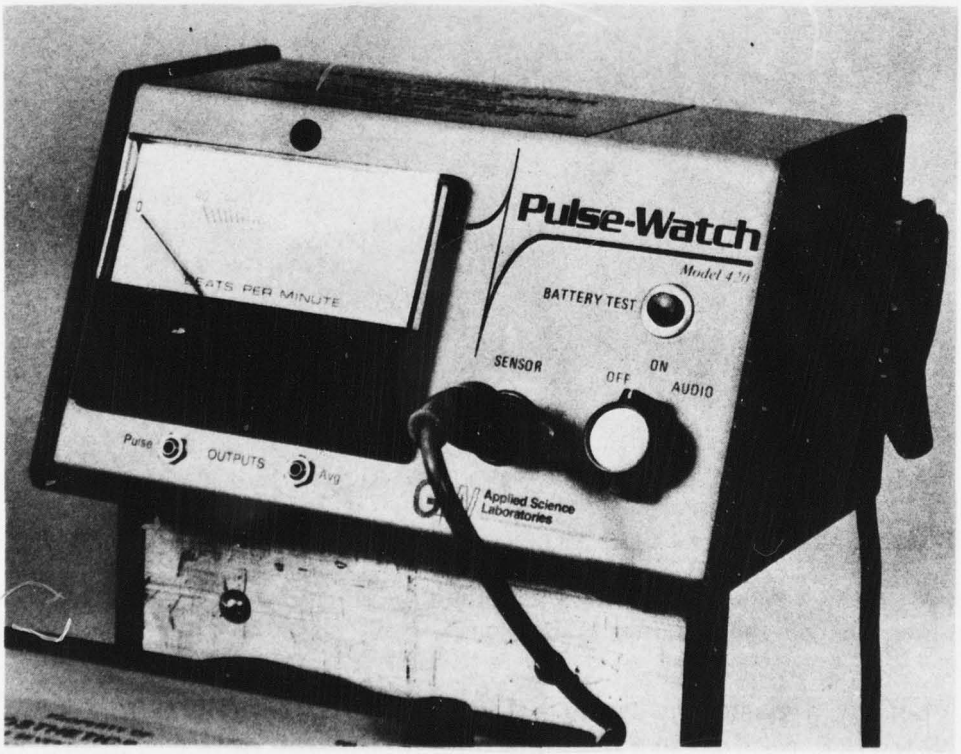


FIGURE 38. — Pulse Watch Model 420.

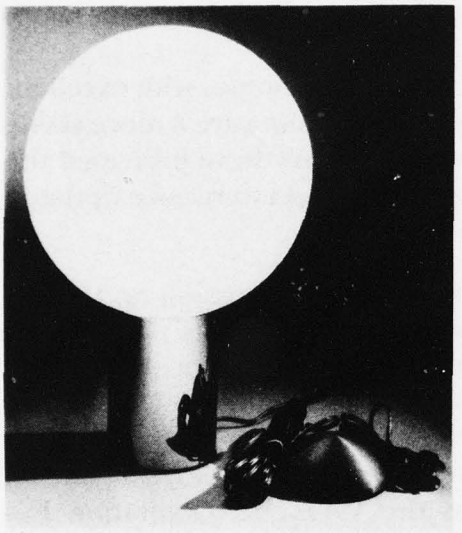


FIGURE 39. — Touch-Lite.

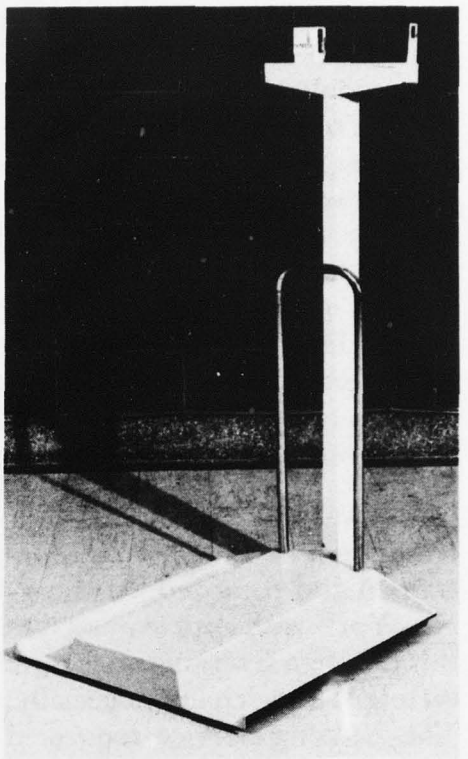


FIGURE 40. — Wheelchair Scale.

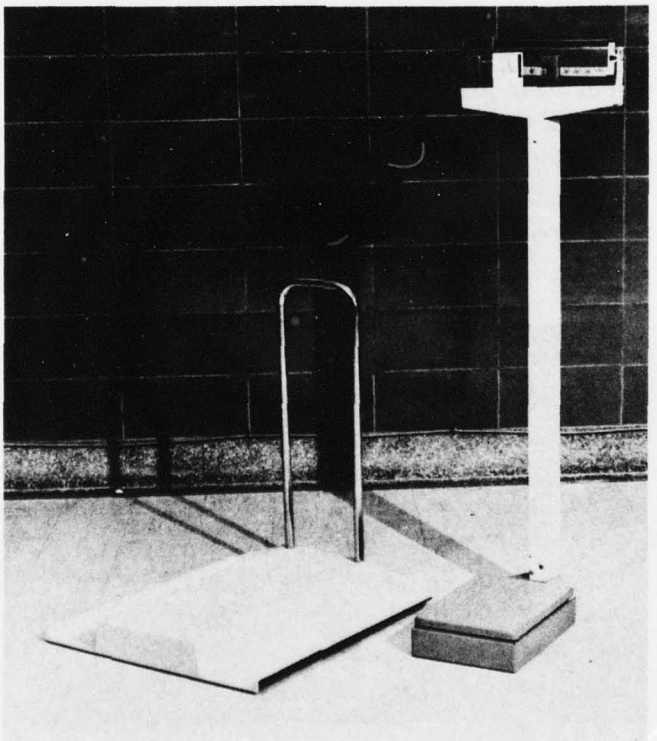


FIGURE 41. — Wheelchair Scale with platform removed.

not be operated by means of environmental controls. Manufactured by Sof-Touch, Inc., Boulder City, Nevada, the Touch-Lite is available in two models: a simple capacitance-sensitive lamp that can be turned on and off by simply touching the base of the lamp with any part of the anatomy, including the hand or fingers; the other (as illustrated) is a three-way unit. Successively touching the lamp base turns the unit on and raises it to higher levels of illumination. Standard three-way lamps are used.

The Touch-Lite is being evaluated in veterans' homes with excellent results. The only necessary modifications we foresee are a more stable base and a means of fastening the large globe. We have informed the manufacturer of our recommendations and expect to receive updated models within the next several months.

d. *Wheelchair Scales.* According to the Joint Commission on the Accreditation of Hospitals, monthly weights of in-patients must be obtrained and recorded. At the VA Extended Care Center, St. Albans, New York, with approximately 80 percent wheelchairbound residents, this problem is serious since no effective means of weighing patients in different wheelchairs, especially the newer powered types, is available. The Nursing Service requested that the VAPC Rehabilitation Engineering Service attempt to solve this problem.

A review of commercial wheelchair scales suggested that all were essentially similar. A conventional balance scale is modified to receive a custom fabricated platform (Fig. 40 and 41), which is intended to support a wheelchair and its occupant for weighing purposes.

We noted several serious problems. First, the platform is supported on the balance scale platform in such a way that the center of gravity of the wheelchair, occupant and wheelchair platform is significantly off-center, thereby producing weight readings that are often erroneous. Further problems are demonstrated when wheelchair leg rests or

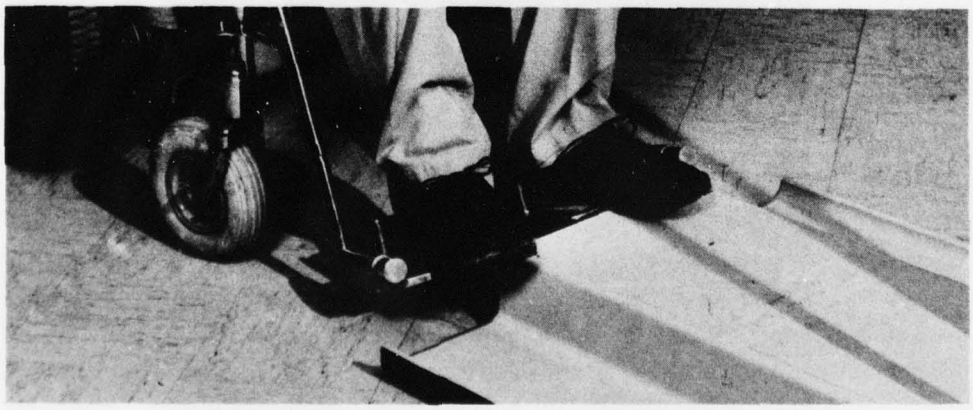


FIGURE 42. — Front approach to wheelchair scale showing interference with foot pedals of wheelchair.

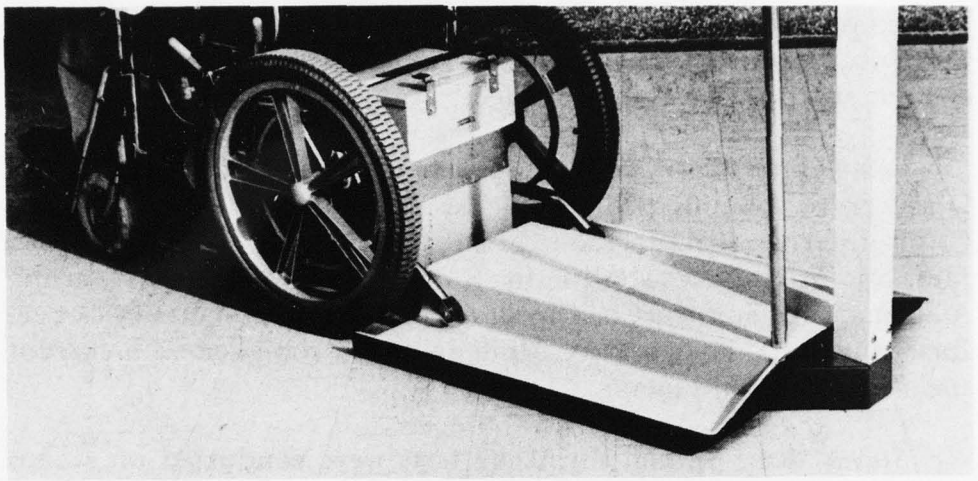


FIGURE 43.—Rear approach to wheelchair scale showing interference with battery case of powered wheelchair.

footplates have been adjusted to low positions for tall individuals.

With footplates in the low position, a mechanical interference occurs between the footplates and the center section of the wheelchair scale platform when the patient attempts to enter upon the platform in a forward direction (Fig. 42). Some of the newer powered wheelchairs are equipped with low battery trays; these present mechanical interference if the user attempts to enter upon the platform in reverse (Fig. 43).

After considering this problem as presented by several types of manual and powered wheelchairs, and discussing the matter with members of the Nursing Service at the VA Extended Care Center, St. Albans, New York, it was determined that a useful and practical wheelchair scale would require a relatively low support or weighing platform, mated to an inclined section to facilitate entry onto the platform. Furthermore, the support base, which would house the weight sensors, must be sufficiently wide so that even if a patient and his wheelchair are not physically located in the center, readings will be of sufficient accuracy to be useful.

Several manufacturers have been contacted concerning this problem. The initial development approach involves an electromechanical system with a sufficiently wide weight-support base to provide accurate readings. The weight read-out will be digital in both the english and metric systems. The initial prototype should be in clinical evaluation by March 1979.

II. COMPLIANCE TESTING

Shrinkage Tests

a. *Herringbone Corset Material.* Three samples of 50 percent cotton, 50

percent polyester fabric were submitted for testing by Meadtex Fabrics Co., Inc., New York, New York. All samples tested complied with current specification requirements.

b. *Coutil Corset Material.* Three specimens of each, 15 in all, of coutil fabrics were submitted for testing by the following manufacturers: Camp International, Jackson, Michigan; Kellogg Industries, Inc., Jackson, Michigan; Medipedic Surgical Supply Co., Warrior, Alabama; Atco Surgical Co., Cuyahoga Falls, Ohio; and Frederick Lee, Inc., Mayaguez, Puerto Rico. All items tested complied with current specification requirements.

c. *Stump Socks.* Special shrinkage tests were conducted on stump socks submitted by Knit-Rite, Inc., Kansas City, Missouri. All items tested complied with current specification requirements.

III. THE VAPC CLINIC TEAM

The statistical breakdown in Table 1 of veterans treated by the clinic team during the latter 6 months of 1978, is a typical case load that is similar to those presented in previous BPR reports. Of the total, 3 were World War I veterans, 427 were World War II veterans, 6 were Korean War veterans, and 142 were Vietnam War veterans. In addition, 28 Israelis, 1 Yugoslav, and 1 Costa Rican veterans were treated. Of the total, 479 were treated for service-connected injuries while 129 were treated for injuries that were non-service-connected.

TABLE 1.—*Breakdown of Patient Disabilities*
July 1, 1978 to December 31, 1978

Amputation		
Area of involvement	Specific level of involvement	Number of patients
Lower-limb unilateral	Below-Knee	167
	Above-Knee	135
	Transmalleolar (Syme's)	23
	Hip (Disarticulation)	14
Lower-limb bilateral	Below-Knee	27
	Above-Knee/Below-Knee	4
	Above-Knee	13
	Transmalleolar (Syme's)	1
	Below-Knee/Transmalleolar (Syme's)	1
	Above Knee/Hip (Disarticulation)	1

Upper-limb unilateral	Below-Elbow	11
	Above-Elbow	6
Upper-limb bilateral	Above-Elbow	3
	Above-Elbow/Shoulder Disarticulation	1
Triple	Below-Knee/Below-Knee/Below-Elbow	2
	Below-Knee/Above-Elbow/Hip Disarticulation	1
		410 Total

Neuromuscular or Skeletal Impairment

Lower-limb unilateral	Ankle-Foot	85
	Knee-Ankle-Foot	29
	Knee	1
Lower-limb bilateral	Ankle-Foot	6
	Knee-Ankle-Foot	7
	Ankle-Foot/Knee-Ankle-Foot	2
Upper-limb unilateral	Arm-elbow-forearm; wrist-hand	4
Trunk	Lumbosacral spin	8
Miscellaneous	Varied (Wheelchairs, shoes, etc.)	55
		197 Total

Amputation and
Neuromuscular or Skeletal Impairment

Lower-limb bilateral	Above-Knee/Ankle-Foot	1 Total

NOTES AND NEWS

DR. JAMES C. CRUTCHER OF ATLANTA, GEORGIA IS NEW VA CHIEF MEDICAL DIRECTOR

Administrator Cleland announced the appointment of Dr. James C. Crutcher, 53, as the VA's Chief Medical Director. He described the new CMD as "a combat veteran and an eminent physician who will provide the kind of forceful, dynamic leadership required for the VA program to provide a quality of medical care second to none."

In his response, the long-time VA career physician said: "The DM&S has made tremendous progress in continually improving the quality of care, the clinical areas for teaching, and the resources for creative research. Upon these well deserved areas of demonstrated success, I wish to intertwine a commitment to maintaining the individual integrity, sensitivity, and respect for each patient we serve."

An American Board certified specialist in Internal Medicine, Dr. Crutcher first joined the VA as a resident in internal medicine at Atlanta VA Hospital in 1952. He later served at that hospital for 20 years as chief of the Medical Service. In his 26-year career at the Atlanta hospital he has also served as admission officer, associate chief of staff for research and development, and associate chief of staff for medical education.

Since 1954 Dr. Crutcher has also been on the faculty of Emory University School of Medicine in Atlanta, and presently is a professor of medicine as well as a professor of allied health sciences at the university.

Dr. Crutcher was a Phi Beta Kappa graduate of Duke University where he also received the M.D. Degree and was elected to Alpha Omega Alpha honorary medical society.

The new CMD enlisted as a Navy apprentice seaman in World War II, and became a pharmacist's mate. Returning to active duty in 1949, he served in the Army Medical Corps as a battlefield surgeon in Korea. Discharged as a captain, he is presently a brigadier general in the Army Reserve Medical Corps and is chairman of the U.S. Army Surgeon General's Advisory Committee Council.

Dr. Crutcher has served in several national capacities with the VA. He has been president of the Association of VA Chiefs of Medicine, chairman of the VA Medical Field Advisory Group, a member of the VA's national Task Force for Ambulatory Care, and chairman of the

VA's Cooperative Studies of Sarcoidosis.

Dr. Crutcher's medical school students at Emory have selected him as "Best Clinical Professor" and have twice chosen him as their commencement speaker.

DONALD L. CUSTIS, M.D., APPOINTED VA DEPUTY CHIEF MEDICAL DIRECTOR

Dr. Donald L. Custis, the VA's Deputy Assistant Chief Medical Director for Academic Affairs and formerly Surgeon General of the Navy, has been named Deputy Chief Medical Director.

Associated with Dr. James C. Crutcher, who became Chief Medical Director, Dr. Custis succeeds Dr. Laurance V. Foye, Jr., who transferred to San Francisco VA Medical Center as Director.

Dr. Custis is a graduate of Wabash College and Northwestern University Medical School. He served from 1944 to 1946 as a medical officer on a Navy attack transport. After 10 years in further training and private practice as a surgeon, he returned to the Navy as a staff surgeon at Portsmouth, Va., Naval Hospital.

Dr. Custis recently was awarded the Distinguished Service Medal. In addition, he has the Legion of Merit with Combat V for his service in Vietnam and numerous other military decorations and honors. He is on the board of trustees of the American Hospital Association and a member of the House of Delegates of the American Medical Association.

DR. HAYS APPOINTED ASSISTANT CHIEF MEDICAL DIRECTOR FOR RESEARCH AND DEVELOPMENT

Dr. Marguerite Hays has been appointed Assistant Chief Medical Director for Research and Development. She had been Director of the Medical Research Service, the largest component, which supports intramural investigators in VA medical centers, including two Nobel laureates. Others are the Rehabilitative Engineering R&D Service, whose activities are described in this Bulletin, and the Health Services R&D Service, which studies means to improve the VA health care system.

Dr. Hays joined VA's Los Angeles Medical Center in 1967, later becoming chief of nuclear medicine at Buffalo VAMC and heading the center's research and education program. She is board-certified in both internal medicine and nuclear medicine.

She describes herself as an "incurable researcher" who has been involved in scientific investigation since her undergraduate days as an astronomy major at Radcliffe. After graduating cum laude from

Radcliffe, she continued her education and research activities at Harvard and UCLA medical schools. She was a postdoctoral fellow with the U.S. Public Health Service, a visiting research scientist at Euratom in Italy, and a faculty member and research endocrinologist at UCLA.

Betty Uzman, M.D., has been appointed as director of VA's Medical Research Service, the position formerly held by Dr. Hays. Dr. Uzman was special assistant to the director of the service.

MAX CLELAND, VA ADMINISTRATOR OF VETERANS AFFAIRS, INVITED TO ATTEND CABINET MEETINGS

President Carter has invited Max Cleland to attend his bi-weekly Cabinet Meetings.

In the President's letter to Mr. Cleland he stated that "Veterans and their dependents and survivors comprise nearly 50 percent of the population of this country; your programs affect nearly every family in the United States. Your programs range from the largest health care and medical system in the world to a multi-billion dollar compensation and pension program; from G.I. housing and home loans to burial benefits and the National Cemetery System; and from the largest and most successful student assistant program to a multi-billion dollar insurance system."

NEW BOOK DEDICATED TO MAX CLELAND

"Disorders Among Vietnam Veterans," edited by Dr. Charles R. Figley, has been dedicated to Max Cleland, Administrator of Veterans Affairs of the Veterans Administration.

According to Mr. Cleland, the book will broaden understanding of why the VA and the public must continue to provide support for Vietnam veterans. The publisher, Brunner/Mazel of New York City, describes the 375-page book as "providing the first comprehensive report of the long-term psychological effects of Vietnam on those who fought there and came home."

VA ESTABLISHES THE OLIN E. TEAGUE AWARD FOR OUTSTANDING EMPLOYEE ACHIEVEMENTS IN REHABILITATION

VA employees, or teams of employees, whose achievements in the rehabilitation of war injured veterans are outstanding, will be eligible for the newly established annual Olin E. Teague Award.

When Administrator Cleland announced the award, he stated that no accomplishment better portrays the distinctiveness of the VA's mission than the rehabilitation of war-injured veterans, and that it was most fitting for the award to bear the name of Representative Teague,

one of the most decorated combat-disabled soldiers of World War II.

Representative Teague has served 31 years on the House Committee on Veterans' Affairs and for 18 of those years was Committee Chairman.

The new award will recognize annually an accomplishment that involves improvement of the quality of life for the war-injured veteran, or that contributes in an outstanding way to the veteran's rehabilitation. The accomplishment may be based on medical or educational rehabilitation, or both. Medical, social science, vocational counseling, engineering, or basic science full-time personnel are eligible to be nominated through their department, staff office, or field station heads.

Nominations for the first Olin E. Teague Awards are no longer open. Those for the second award should be made, through channels, to the VA Incentive Awards Staff (05A2), before November 1979.

SURVEY OF THE STATUS AND PROSTHETIC NEEDS OF SERVICE CONNECTED AMPUTEES

Mr. Sol Kaminsky, Project Director, Jerome Siller, Ph.D., Consultant, and Patrick Brosnan, Assistant Project Director, of the National Amputation Foundation, 12-45 150th Street, Whitestone, New York 11357, are heading up a nationwide study.

This survey of 1200 service connected amputees is being conducted to establish a basic data base that will provide information on their prosthetic, medical-surgical, employment, and psychosocial characteristics. Veterans of W.W. II, Korea, and Vietnam with all types of amputations will be interviewed by means of an extensive questionnaire. A special feature of the survey is that interviewers will themselves be service-connected amputees who attended a special training seminar in administration of the questionnaire.

Numerous analyses regarding such matters as satisfaction with prosthetic equipment and services, incidence of medical conditions for amputees of different types and ages, vocational and educational status as compared to nonamputees, family and marriage experiences will be reported. Data collection commences January 1979.

J. M. WOOLLY AND R. H. BENNETT AWARDED 1978 MIGEL MEDAL

The 1978 recipients of the Migel Medal, given annually in recognition of outstanding contributions in education, rehabilitation and social welfare of the blind, are James Max Woolly, LL.D., and Robert H. Bennett. Mr. Woolly is superintendent of the Arkansas School for the Blind, Little Rock; Mr. Bennett is a member of the board of directors of

the New York Association for the Blind (Lighthouse), New York City, and the National Industries for the Blind, Bloomfield, New Jersey.

The medal, established in 1937 to honor the late M. C. Migel, first president of the American Foundation for the Blind, is given annually by AFB.

Dr. Woolly began his career as a teacher, then principal of the Arkansas School for the Blind: since 1947 he has been the school's superintendent. He was elected to AFB's board of trustees in 1962 and has served on the executive committee, as vice president, since 1967. He also currently chairs the editorial advisory board of the Journal of Visual Impairment and Blindness.

Robert H. Bennett began his career in the field of blindness in 1962 when he retired, after 40 years in sales and advertising, as marketing vice president of General Foods. He was elected to the board of directors of the Lighthouse in 1963 and served as its president from 1972 to 1974. In 1976 Mr. Bennett was the recipient of the National Industries for the Blind Workshop Board Member of the Year Award.

BEDFORD HOSPITAL RENAMED FOR EDITH NORSE ROGERS

After 50 years of service to veterans, Bedford VA Medical Center has been rededicated in honor of the late Congresswoman Edith Norse Rogers, only woman to chair the House Veterans' Affairs Committee. Bedford is among the first major Federal facilities named for a woman.

Mrs. Rogers was especially interested in amputees and other seriously disabled veterans. In the period after World War II, she conducted numerous hearings on their problems and stimulated many important pieces of legislation. One, for instance allowed the Administrator to provide prosthetic devices, and training in their use, by any of a variety of means without regard to other provision of law; thus multiple contracts could be negotiated with prosthetics facilities to allow an eligible amputee to choose among many facilities in the three cities nearest to his home, instead of being confined to a single lowest bidder. Another provided an allowance for an automobile, first for those with loss or loss of use of a lower limb and later for other amputees and the blind. Mrs. Rogers pressed for passage of P.L. 729 of the 80th Congress which authorized a permanent research and development program on prosthetic and sensory aids and authorized making the results available so all disabled might benefit; this and subsequent recodifications authorize the present rehabilitative engineering research, development, and education programs and the publication of numerous documents including this Bulletin.

Congresswoman Margaret Heckler, who introduced the bill to honor Mrs. Rogers, was also at the ceremony. According to Congresswoman Heckler, "The dedication of this hospital is a symbol of the

great contribution women are making everywhere in American society."

Bedford originally accommodated 354 veterans, of whom approximately 90 percent received psychiatric care. Today it has 1,000 beds, and 50 percent of the veterans receive general medical and surgical treatment. Advances in psychiatric care in the last few decades have enabled many more veterans to be treated as outpatients and to return to their homes and families.

EUGENE J. TAYLOR, 1913-1978

Eugene Jackson Taylor, former writer who worked with Howard A. Rusk, M.D., and medical consultant for the New York Times, died December 2, 1978 in Schenectady, New York.

Mr. Taylor was a graduate of Kansas State Teachers College in 1936 and received his master's degree in speech from State University of Iowa in 1939. He held honorary doctorates of law and letters from Chungang University in Korea and Adelphi College, respectively.

Having served on the editorial staffs of the New York Times, 1945-1970 and Medical World News, 1968-1970, Mr. Taylor was also an adjunct professor for the Department of Rehabilitation Medicine, New York University Medical Center and from 1957 to 1978 he was secretary-treasurer for the World Rehabilitation Fund.

Active in government service, he was a former member of the National Advisory Committee on Vocational Rehabilitation; National Commission on Architectural Barriers; Research Fellowship Committee, Social Rehabilitation Service for the Department of Health, Education and Welfare, the department's Medical Assistance Advisory Council; National Committee on Manpower Training; Advisory Committee of the New York State Health Planning Commission and the Hospital Review Planning Council for the state.

Mr. Taylor was also a former consultant for Health Resources Advisory Committee, Office of Defense Mobilization and Office of Vocational Rehabilitation, Social and Rehabilitation Service of DHEW.

His many memberships included the American Congress of Rehabilitation Medicine, National Rehabilitation Association, International Association of Rehabilitation Facilities, American Association for the World Health Organization, International Society for Prosthetics and Orthotics, American Association for Mental Deficiency, International Society for Occupational Therapy and Committee on the Handicapped, People-to-People Program.

A recipient of numerous prestigious awards, he received the President's Award, the Gold Key, National Rehabilitation Association, American Congress of Physical Medicine and Rehabilitation, Citation from the Mexican Soceity for Physical Medicine and Rehabilitation, La

Medaille D'Argent de la Ville de Paris, and the U.S. Army Legion of Merit.

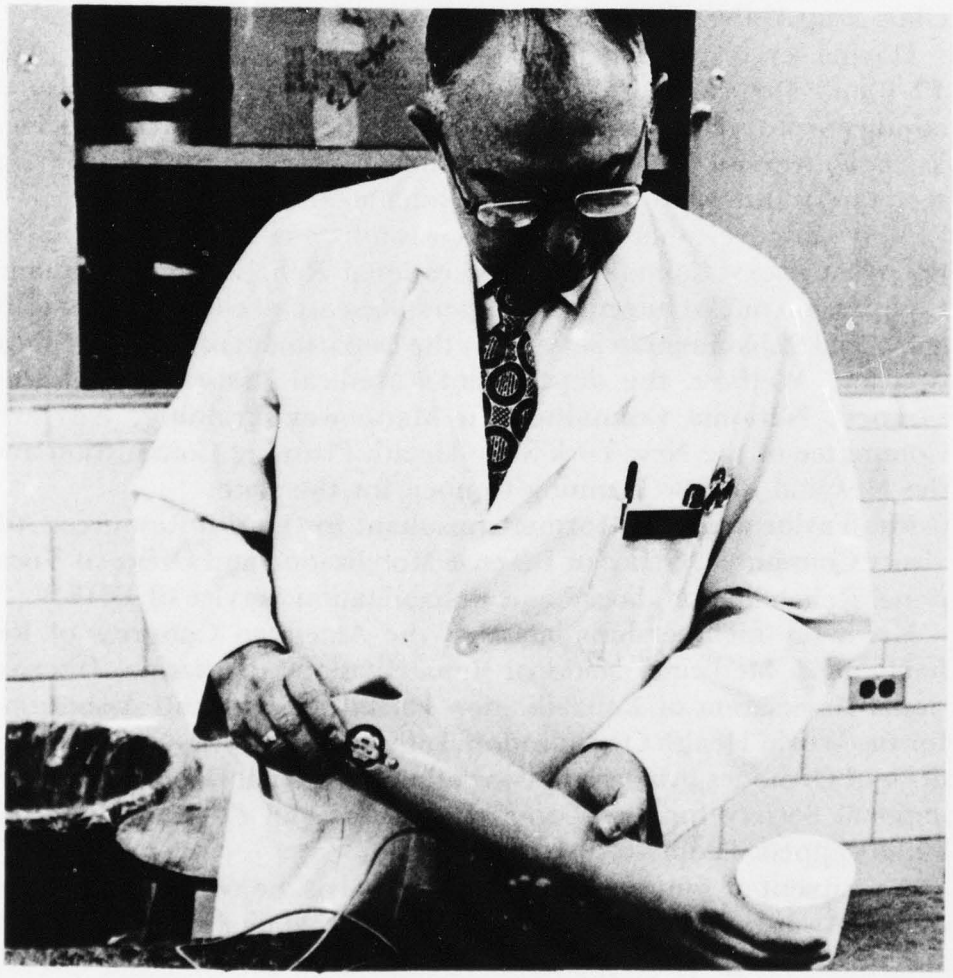
With Dr. Rusk, Mr. Taylor wrote "New Hope for the Handicapped," "Living with a Disability," and "Rehabilitative Medicine."

All will miss Jack's warm smile and easy going ways. In Dr. Rusk's words at a memorial service for him, "Disabled people all over the world are walking and working today because he cared and gave his life for their cause. They, as well as we his friends, will always remember his compassion, goodness, and dedication."

Tamara T. Sowell, R.P.T.

BERT R. TITUS, C.P.O., 1924-1978

Bert R. Titus, Director of the Department of Prosthetics and Orthotics at Duke University Medical Center, died suddenly at his home in Durham, North Carolina on December 17, 1978 at the age of 54. With his death, we lost an illustrious professional and a beloved friend.



Bert R. Titus, C.P.O., 1924-1978

Bob, as he was known to his friends, was born in Sioux City, Iowa, in 1924 and grew up on farms in northern Iowa and southern Minnesota. He attended Mankato State College and later the University of North Carolina. He never really left the farm, however, and almost every year timed his vacation to coincide with the harvest back home.

While in the Army, during World War II, Bob sustained a broken leg that occasioned a long period of light duty. During this time, he was assigned to a hospital brace shop, an activity that started his career.

Bob first came to North Carolina in 1943 as a soldier, being stationed at Camp Butner with the Army's 78th Division. While there, he met and fell in love with Virginia Jones, a Durham girl, whom he subsequently married.

He became associated with the Duke University Brace Shop in 1947 becoming Director in 1948. Over the years, this grew to be the Department of Prosthetics and Orthotics, and Bob, always a willing teacher, was promoted to the rank of Associate Professor of Prosthetics and Orthotics.

He was eager to innovate, to try new techniques and ideas, and he responded to challenge like it was fun.

Bob was Certified by the American Board for Certification in both Prosthetics and Orthotics and later served a term as its President. He was active in both the American Orthotic Prosthetic Association and the American Academy of Orthotists and Prosthetists. He organized and chaired several regional meetings. He was a founding Member and President of the North Carolina Society of Prosthetists and Orthotists. A member of the Committee on Prosthetics Research and Development of the National Academy of Sciences-National Research Council, he was very active on several of its subcommittees and panels. He was a Fellow of the International Society for Prosthetics and Orthotics and at the time of his death, was Treasurer of its United States Committee.

Bob Titus put a high value on family, friends, and church. He was proud of Virginia and their daughter Karen, and was ecstatic about his two grandchildren. He was a Member of the Angier Avenue Baptist Church in Durham which he attended regularly, both Services and Sunday School. He was a deacon, having served as Chairman of the Board of Deacons, Building Fund Chairman, Chairman of the Pastoral Search Committee, and at the time of his death, Assistant Treasurer of the Church. He had been active in the Optimist Club of Durham and was a Mason and a Shriner.

We will miss Bob, as a colleague, a friend, a citizen, and as an intellectual challenger who had a knack of pointing out our mistakes in a quiet but firm way that made us want to say "thank you".

We will continue to say "thank you" for many years.

Frank W. Clippinger, Jr., M.D.

RECENT PATENTS[a]

Adjustable Wheel Chair: Gilbert E. Haury, assignor to Invacare Corp., Elyria, Ohio. An adjustable wheelchair which facilitates independent seat height and width adjustments to accommodate varying wheelchair height needs. (Patent No. 4,082,348, Apr. 4, 1978; filed Mar. 1. 1976, Appl. No. 662,892; 13 claims.)

Cushioning Effect: Charles W. Morgan, assignor to The Dow Chemical Co. A cushioning element is provided which is prepared from a synthetic resinous cellular resilient body. A plurality of intersecting grooves are formed in the surface of the cushioning element which provides a body-supporting surface of a plurality of spaced-apart bosses generally independently deflectable and recoverable. (Patent No. 4,070,719, Jan. 31, 1978; filed Sept. 1, 1976, Appl. No. 719,498; 5 claims.)

Differential-Pressure Flotation Cushion: Richard S. Carlisle. A flotation-type, low-pressure-gas (or fluid) cushion for the prevention of pressure sores has been designed. The device has a plurality of longitudinal compartments, the outer compartments are of much greater size than the inner and communicate with the inner compartments by restrictive passageways. The sum of the pressures generally is less than half the pressure ordinarily exerted against the ischial tuberosities by a folding wheelchair, flexible sling-type seat. (Patent No. 4,073,021, Feb. 14, 1978; filed Mar. 3, 1976, Appl. No. 663,544; 9 claims.)

Dynamic Column Support for Feeder Pan: Leland D. Miller. This apparatus is designed to support a patient's arm in a feeder pan or tray to enable the user to perform manipulative tasks with his hand and fingers without relying on the arm or shoulder muscles. The tray easily moves in any horizontal direction to a desired position within the limits of the apparatus without tipping or tilting. (Patent No. 4,069,995, Jan. 24, 1978; filed Nov. 16, 1976, Appl. No. 742,514; 9 claims.)

Lifting Device: Lars A. Nilsson. A lifting device for lifting patients which has a horizontal carrier bar with one free end, the other end connected by means of a lever to a shaft rotatably mounted in a support, and a shaft parallel to the carrier bar. (Patent No. 4,086,672, May 2, 1978; filed July 26, 1976, Appl. No. 708,772; 24 claims.)

Method and Apparatus for Communicating with People: Charles J. Laenger, Sr., Sam R. McFarland, and Harry H. Peel, assignor to Southwest Research Institute, San Antonio, Texas. A method and apparatus for communicating with people who are both deaf and blind has been developed. The apparatus has a keyboard controlling an electromechanical hand. The hand is programmed to form the letters of a one-hand manual alphabet through the use of an electronic buffer between the electric typewriter and the hand. Deaf and/or deaf and blind people feel the configurations of the electromechanical hand and are able to identify the letters. This provides an effective means of communication by people who do not know the one-hand manual alphabet

[a]Patents may be ordered by number from the Commissioner of Patents, Washington, D.C., 20231, at 50¢ each.

with people who are deaf and blind. (Patent No. 4,074,444, Feb. 21, 1978; filed Sept. 30, 1978, Appl. No. 728,404; 12 claims.)

Seating Unit for a Bath Tub, Shower Stall or the Like: Russell P. Lotta. A seating unit is adapted to support a person in a sitting position in a bath tub or shower stall and may be folded and stored compactly when not in use. (Patent No. 4,087,127, May 2, 1978; filed Apr. 25, 1977, Appl. No. 790-401; 1 claim.)

Vehicle Wheelchair Ramp: Donald L. Rohrs, Harold A. Downing, and Donald L. Collins, assignor to Collins Industries, Inc., Hutchinson, Kansas. A vehicle wheelchair ramp for loading and unloading an occupant confined to a wheelchair. The ramp is hingably mounted on the floor of the vehicle and unfolds outwardly from the vehicle for contacting the ground surface, curb, or the like. (Patent No. 4,084,713, Apr. 18, 1978; filed May 3, 1976, Appl. No. 682,387; 4 claims.)

Wheelchair: Earl E. McMunn and Ronald N. McMunn. A wheelchair which includes a main frame supported in the front and rear by pairs of wheels. The main frame interconnects the back rest, seat, and leg rest frame segments in such a manner to allow the segments to be adjusted between positions supporting a patient in the upright sitting position and in the fully reclining position. (Patent No. 4,079,990, Mar. 21, 1978; filed Apr. 16, 1976, Appl. No. 677,558; 5 claims.)

Wheelchair Controls: Robert E. Brown and Raymond Hatfield, assignor to Biddle Engineering Co., Ltd., England. A control unit for a motorized wheelchair which has a part engageable with the occupant's chin. The patient can control the wheelchair in a forward direction and in a second and third direction to steer the chair either to the left or to the right; an on/off and reverse/forward switch is provided operable by the occupant's head. (Patent No. 4,078,627, Mar. 14, 1978, filed May 11, 1976, Appl. No. 685,479; 5 claims.)

PUBLICATIONS OF INTEREST

PROSTHETICS

Amputation: Energy Cost of Ambulation, Chi-Tsou Huang, James R. Jackson, Nancy B. Moore, Philip R. Fine, Keith V. Kuhlemeier, George H. Traugh, and Patricia T. Saunders; Arch. of Phys. Med. and Rehab., 60(1):18-25, Jan. 1979.

Analysis of Variability in Pylon Transducer Signals, Dr. Jones and J.P. Paul; Pros. & Ortho. Int'nl., 2(3):161-167, Dec. 1978.

Clinical Application Study of Multifunctional Prosthetic Hands, Peter Herberts, Christian Almström, and Kerstin Caine; J. Bone & Joint Surg., 60-B (4):552-561, Nov. 1978.

Clinical Evaluation of a Myoelectrically Controlled Multifunctional Hand, Christian Peter Kerstin Almström, P. Herberts, and K. Caine; Orthopädie Technik, 29(6):77-78, June 1978.

Difficulties and Complications of Prosthetic Supply of Geriatric Patients, G. Bogner, H. Schönbauer, and H. Layr; Orthopädie Technik, 29(8):97-99, Aug. 1978.

Effectivity of Plastic Surgical Separation of Below-Elbow-Stumps, S.M. Lischnewsky; Orthopädie Technik, 29(9):114-116, Sept. 1978.

Electrocutaneous Tracking: A Methodology for Evaluating Sensory Feedback Codes, Andrew Y. Szeto, Ronald E. Prior, and John Lyman; IEEE Transactions on Biomedical Engineering, 26(1):47-50, Jan. 1979.

Electrotactile Two Point Discrimination as a Function of Frequency, Pulse Width and Pulse Time Delay, M. Solomonow, L. Raplee, and J. Lyman; Annals of Biomed. Engng., 6(2):117-126, June 1978.

HRC Adjustable Pneumatic Swing-Phase Control Knee, S. Nakamura and S. Sawamura: Pros. & Ortho. Int'nl., 2(3):137-143, Dec. 1978.

Improved A/K Stump Adaptation by Means of a Variable Air Pressure Socket, W.G. Biedermann and J. Holtkamp; Orthopädie Technik, 29(8):99-102, Aug. 1978.

An Instrument for Monitoring Stump Oedema and Shrinkage in Amputees, G.R. Fernie, P.J. Holliday, and R.J. Lobb; Pros. & Ortho. Int'nl. 2(2):69-73, Aug. 1978.

Limb Prosthetics for Vocational Rehabilitation Workers, A.B. Wilson, Jr., M. Boblitz, and A.R. Meece; 1978, $4.00, Rehabilitation Engineering Center, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pa. 19141.

Manual for an Ultralight Below-Knee Prosthesis, A.B. Wilson, Jr., C. Pritham, and M.

Stills; 1977, 51 pp, $3.00, Rehabilitation Engineering Center, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pa. 19141.

Measurement of Prosthetic Alignment, N. Berme, C.R. Purdey, and S.E. Solomonidis; Pros. & Ortho. Int'nl., 2(2):73-76, Aug. 1978.

The Mechanics of the Knee and Prosthesis Design, J. Goodfellow and J. O'Connor; J. Bone and Joint Surg., 60-B/3:358-370, Aug. 1978.

The Orthopaedic Management of Foot Amputees: Part 2: Technical Design, B. Weckenmann; Orthopädie Technik, 29(12):165-168, Dec. 1978.

OTTO BOCK Alignment System for the Manufacture of Advanced Prostheses, M. Nader; Orthopädie Technik, 29(12):176-177, Dec. 1978.

Partial or Complete Resection of the Hemipelvis. An Alternative to Hindquarter Amputation for Periacetabular Chondrosarcoma of the Pelvis, H.H. Steel; J. Bone and Joint Surg., 60-A/6:713-719, Sept. 1978.

Pattern-Recognition Arm Prosthesis: An Historical Perspective, R. Wirta, D. Taylor, and F.R. Finley; 1978, 30 pp. $3.00, Rehabilitation Engineering Center, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pa. 19141.

Phantom Limbs and Related Phenomena in Recent Traumatic Amputations, P.L. Carlen, P.D. Wall, H. Nadvorna, and T. Steinbach; Orthopaedic Survey, 2(1):31-33, July-Aug. 1978.

Postural Sway in Amputees and Normal Subjects, G.R. Fernie and P.J. Holliday; J. Bone and Joint Surg., 60-A/7:895-899, Oct. 1978.

Prosthetic Principles in Bilateral Shoulder-Disarticulation or Bilateral Amelia, G. Neff, Prosth. & Ortho. Int'nl., 2(3):143-148, Dec. 1978.

Some Experience in Fitting a Myoelectrically Controlled Hand Which has a Sense of Touch, G.F. Shannon; J. Med. Engng. & Tech., 2(6):312-315, Nov. 1978.

Spenco-Lynadure Soft Inserts, M.T. Wilson; Ortho. & Prosth., 32(3):21-25, Sept. 1978.

The SVEN-Hand Prosthesis, L. Hedström and H. Lymark; Orthopädie Technik, 74-76, June 1978.

Trends in Powered Upper Limb Prostheses, I. Kato; Pros. and Ortho. Int'nl., 2(2): 64-69, Aug. 1978.

Vulcanized Rubber Foot for Lower Limb Amputees, P.K. Sethi, M.P. Undawat, C. Kasliwal, and R. Chandra, Pros. & Ortho. Int'nl., 2(3):125-137, Dec. 1978.

ORTHOTICS

Ambulation in Thoracic Paraplegia, E.S. Stauffer, M.M. Hoffer, and V.L. Nickel; J. of Bone and Joint Surg., 60-A/6:823-825, Sept. 1978.

Ambulation Without Wheelchairs for Paraplegics with Complete Lesions, H. Natvig and R. McAdam; Paraplegia, 16(2):142-147, Aug. 1978.

An Ankle-Foot Orthosis for Immobilization of the Ankle, H.E. Kramer and W.D. Arnold; Ortho. and Prosth., 32(3): 1-3, Sept. 1978.

The Boston-Brace, J. Fischer; Orthopädie Technik, 29(9):109-112, Sept. 1978.

Experience in the Treatment of Femoral Shaft Fractures Using a Vitrathene Cast Brace, J.D. Colley and B.A. Roper; Prosth. & Ortho. Int'nl., 2(2):76-79, Aug. 1978.

A Force Measuring Forearm Crutch for the Control of Partial Weightbearing, G. Bergmann, R. Kölbel, A Rohlmann, et al.; Orthopädie Technik, 29(8):102-106, Aug. 1978.

Hand Orthosis for Various Finger Impairments — The KU Finger Splint, H. Watanabe, K. Ogata, T. Okabe, et al.; Prosth. & Ortho. Int'nl., 2(2):95-101, Aug. 1978.

Lower-Limb Orthotics: A Manual, A.B. Wilson, Jr., D. Condie, C. Pritham, and M. Stills; 1978, 124 pp. $10.00, Rehabilitation Engineering Center, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pa. 19141.

Orthotic Management for Genu Recurvatum and Genu Varus, J.C. Weintrob and M.M. Kendrick; Ortho. and Prosth., 32(3): 25-32, Sept. 1978.

A Pelvic Immobilization Device in Total Hip-Replacement Surgery, G.J. Wang, S.I. Reger, and W.G. Stamp; J. Bone & Joint Surg., 60-A/7:1007-1008, Oct. 1978.

The Polypropylene Single-Hip-Spica, D.A. Varnau; Ortho. and Prosth., 32(3):7-21, Sept. 1978.

The Salopskate—An Orthosis for Improving Drag to Gait, J. Stallard and G.K. Rose; Ortho. and Prosth., 32(3):32-37, Sept. 1978.

Some Experience in Fitting a Myoelectrically Controlled Hand Which has a Sense of Touch, G.F. Shannon; J. Med. Engng. & Tech., 2(6):312-315, Nov. 1978.

Tactile Information Processing by Human Operators in Control Systems, H.P. Schmid and G.A. Bekey; IEEE Transactions on Systems, Man, and Cybernetics, 8(12):860-867, Dec. 1978.

Tissue Pressure Tolerance as a Guide to Wrist-Hand Orthosis Design, D. Toderan and T. Lunsford; Ortho. and Prosth., 32(3):37-44, Sept. 1978.

Treatment of Scoliosis with the EDF Plaster Cast, A. Gfoller and W. Gell; Orthopädie Technik, 29(9):112-113, Sept. 1978.

The Use of Lumbosacral Corsets Prescribed for Low Back Pain, S.A. Ahlgren and T. Hansen; Prosth. & Ortho. Int'nl., 2(2):101-105, Aug. 1978.

The Value of Flexor Hinge Hand Splints, P.J.R. Nichols, S.L. Peach, R.J. Haworth, et al.; Prosth. & Ortho. Int'nl., 2(2):86-95, Aug. 1978.

SURGERY

Cervical Dislocation Following Fusion of the Upper Thoracic Spine for Scoliosis. A Case Report, J.C. Drennan and E.W. King; J. Bone & Joint Surg., 60-A/7:1003-1005, Oct. 1978.

Direction of Inertia: The Future for Regulation of Surgical Implant Devices, M.B. Habal, M.S. Karlan, and D. Leake; J. of Clin. Engng., 3(2):186-189, June 1978.

Mechanics of the Knee and Problems in Reconstructive Surgery, R.A. Denham and R.E.D. Bishop; J. Bone and Joint Surg., 60-B/3:345-353, Aug. 1978.

SENSORY AIDS

Attitudes Towards Deafness: Hearing Students at a Hearing and Deaf College, R.G. Emerton and G. Rothman; A. Annals of the Deaf, 123(5):588-594, Aug. 1978.

Cognitive Mapping by the Blind, S.M. Casey; J. Vis. Impair. & Blind., 72(8):297-302, Oct. 1978.

Comment — The Sonicguide: A Valuable Aid for Blind Children and Infants, R.P. Smith and R.H. Dailey; J. of Vis. Impair. & Blind., 72(8):317-326, Oct. 1978.

Complementary Travel Aids for Blind Persons: The Sonicguide Used with a Dog Guide, William Jacobson; J. of Vis. Impair. & Blind., 73(1):10-13, Jan. 1978.

A Course of Resources for the Newly Blind, M. Winer; J. of Vis. Impair. & Blind., 72(8):311-316, Oct. 1978.

The Effect of Prolonged Hearing Aid Use on the Communicative Skills of Young, Deaf Adults, G.G. Walter and D.G. Sims; A. Annals of the Deaf, 123(5):548-555, Aug. 1978.

Instrumentation System for Blind Mobility Aid Simulation and Evaluation, J.A. Brabyn, H.R. Sirisena, and G.R.S. Clark; IEEE Trans. on Biomed. Engng., BME-25(6):556-559, Nov. 1978.

Low Vision Training in Sweden, K. Inde; J. of Vis. Impair. & Blind., 72(8):307-311, Oct. 1978.

A Model of Vision from Concepts of Optical Engineering Theory, R.D. McLeod; J. Clin. Engng., 3(2):119-125, April-June 1978.

Rehabilitation Potential of Hearing-Impaired Clients, J.A. Lafitte; A. Annals of the Deaf, 123(5):580-588, Aug. 1978.

Research and the Mobility Specialist, W.R. De l'Aune; J. of Vis. Impair. & Blind., 72(7):267-273, Sept. 1978.

Spatial and Distancing Behavior of Deaf Adults, Susan A. Holton; A. Annals of the Deaf, 123(8):920-925, Dec. 1978.

Technical Aids for the Speech-Impaired, M. Lundman; The Swedish Inst. for the Handicapped, ICTA Information Centre, Fack S-161-25, Bromma 1, Sweden, 60 pp, March 1978.

Toward Computer Literacy for Visually Impaired Students, S.G. Ryan, Jr. and D.N. Bedi; J. of Vis. Impair. & Blind., 72(8):302-307, Oct. 1978.

The Use of Myoelectric Feedback in Teaching Facial Expression to the Blind, Colleen Webb; Biofeedback and Self-Regulation, 2(2):147-161, June 1977.

Visual Input: Its Importance in the Control of Postural Sway, James Dornan, Geoff R. Fernie, and Pamela J. Holliday; Arch. of Phys. Med. and Rehab., 59(12):586-592, Dec. 1978.

Vocational Evaluation Services for the Deaf and Hearing Impaired, Jack M. Sink, Timothy F. Field, and Melanie H. Raulerson; A. Annals of the Deaf, 123(8):937-945, Dec. 1978.

Why Can't The Deaf Read? Comments on Asking the Wrong Question, K.A. Gormley and A.M. Franzen; A. Annals of the Deaf, 123(5):542-548, Aug. 1978.

GENERAL

Assessment of Standing Aids for the Physically Handicapped, J.S. Paton, A. Shaw, D.W. Hughes, and J. Runcie; J. of Med. Engng. & Tech., 2(6):299-305, Nov. 1978.

Automotive Wheelchair Lifts: Development of Standard Criteria for Their Evaluation, D.D. Duncan, M. McDermott, Jr., and E. Peizer; Arch. Phys. Med. Rehab., 59:437-440, Sept. 1978.

The Avocational Pursuits of Rehabilitants with Traumatic Quadriplegia, J.C. Rogers and J.J. Figone; Amer. J. of Occup. Ther., 32(9):571-577, Oct. 1978.

Bone Loss in Response to Long-Term Immobilization, H.K. Uhthoff and Z.F.G. Jaworski; J. Bone and Joint Surg., 60-B/3:420-430, Aug. 1978.

Calcium Balance in Paraplegic Patients: Influence of Injury Duration and Ambulation, P.E. Kaplan, B. Gandhavadi, L. Richards, and J. Goldschmidt; Arch. Phys. Med. Rehab., 59:447-449, Oct. 1978.

Complications with Use of the Stryker Frame, Peter B. Slabaugh and Vernon L. Nickel; J. Bone and Joint Surg., 60-A/8:1111-1113, Dec. 1978.

Cooperation in a Rehabilitation Centre Between Physician and Orthotist/Prosthetist, F. Bauer; Orthopädie Technik, 29(9):106-108, Sept. 1978.

Devices and Systems for the Disabled, Papers from a Conference held April 1975, E. Kwatny and R. Zuckerman, Publ. 1976, 207 pp. $12.00, Rehabilitation Engineering Center, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pa. 19141.

Educating Wheelchair Patients on Home Architectural Barriers, M.B. Wittmeyer and W.C. Stolov; Amer. J. of Occup. Ther., 32(9):557-565, Oct. 1978.

The Effect of Methylmethacrylate on Bacterial Phagocytosis and Killing by Human *Polymorphonuclear Leukocytes,* W. Petty; J. Bone and Joint Surg., 60-A/6:752-758, Sept. 1978.

Electrocutaneous Nerve Stimulation — 1: Model and Experiment, R. Bütikofer and P.D. Lawrence; IEEE Trans. on Biomed. Engng., BME-25(6):526-532, Nov. 1978.

Evaluation of the Limb Load Monitor, G. Wannstedt and R. Craik; 1978, 75 pp, $3.00, Rehabilitation Engineering Center, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pa. 19141.

Foot-Force Measuring Device for Clinical Assessment of Pathological Gait, S. Miyazaki and H. Iwakura; Med. & Biol. Engng. & Comput., 16:429-436, July 1978.

Future Directions for Biomedical Engineering Research: Recommendations of an Evaluation Workshop for the NIGMS Physiology and Biomedical Engineering Program, P.H. Abbrecht, J.R. Cox, and F.P. Ferguson; IEEE Trans. on Biomed. Engng., BME-25(6):490-494, Nov. 1978.

Genu Recurvatum in Spastic Cerebral Palsy. Report on Findings by Gait Analysis, S.R. Simon, S.D. Deutsch, R.M. Nuzzo, M.J. Mansour, et al.; J. Bone & Joint Surg., 60-A/7:882-895, Oct. 1978.

Hangman's Fracture with Non-Union and Late Cord Compression. A Case Report, A.A. White III and H.L. Moss; J. of Bone & Joint Surg., 60-A/6:839-841, Sept. 1978.

Heterotopic Ossification Around the Hip in Spinal-Cord-Injured Patients, J. Tibone, I. Sakimura, V.L. Nickel, and J.D. Hsu; J. Bone & Joint Surg., 60-A/6:769-776, Sept. 1978.

Interrelationships of EMG Signal Characteristics at Different Levels of Muscle Tension and During Fatigue, J.T. Viitasalo and P.V. Komi; Electromyogr. Clin. Neurophysiol., 18:167-178, 1978.

Isometric Tension Development in a Human Skeletal Muscle in Relation to Its Working Range of Movement: The Length Tension Relation of Biceps Brachii Muscle, H.M. Ismail and K. W. Ranatunga; Exper. Neuro., 62(3):595-605, Dec. 1978.

Kinesiology of the Transplanted Muscle Part 3: Transfers About the Lower Extremity, M. Mussen; Electromyogr. Clin. Neurophysiol., 18:115-146, Oct. 1978.

A Knee Function Assessment Chart, P. Aichroth, M.A.R. Freeman, I.S. Smillie, and W.A. Souter; J. Bone and Joint Surg., 60-B/3:308-310, Aug. 1978.

Limb-Load Alarm Device for Partial-Weight-Bearing Walking Exercise, S. Miyazaki and H. Iwakura; Med. & Bio. Engng. & Comput., 16(5):500-507, Sept. 1978.

Locomotion and the Clinical Analysis of Gait, Report of a Workshop held Dec. 6-8, 1976. Publ. 1977, 165 pp, $3.00, Rehabilitation Engineering Center, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pa. 19141.

A Mathematical Model of Arm Swing During Human Locomotion, K.M. Jackson, J. Joseph, and S.J. Wyard; J. Biomech., 11(6/7):277-291, 1978.

Measures of Severity of Injury, J.P. Bull; Orthop. Survey, 2(1):35-37, Aug. 1978.

A Mechanically-Actuated Wave Mattress, M.N. Brearley and W.M. Motloch; Pros. and Ortho. Int'nl. 2(2):79-81, Aug. 1978.

Medical Ultrasound and Its Biological Effects, V. Veluchamy; J. of Clin. Engng., 3(2):162-167, April-June 1978.

A Method for Measurement of the Vertical Forces and Time Dependent Pressure Distributions, E. Hennig, H. Albert, and U. Aisslinger; Orthopädie Technik, 93-97, Aug. 1978.

On Methods for Preprocessing Direction Doppler Signals to Allow Display of Directional Blood-Velocity Waveforms by Spectrum Analysers, B.A. Coghlan and M.G. Taylor; Med. & Bio. Engng. & Comput., 16(5):549-554, Sept. 1978.

Neuropathic Spine after Spinal Cord Injury. A Case Report, P.B. Slabaugh and T.K. Smith; J. Bone & Joint Surg., 60-A/7:1005-1007, Oct. 1978.

A New Approach to the Management of Wounds of the Extremities: Controlled Environment Treatment and its Derivatives, R.G. Redhead and C. Snowdon; Pros. & Ortho. Int'nl., 2(3):148-157, Dec. 1978.

New System for Recording Ambulatory Blood Pressure in Man, M.W. Millar-Craig, D. Hawes, and J. Whittington; Med. and Bio. Engng. & Comput., 16(6):727-732, Nov. 1978.

Nursing Management in Relation to Beds Used Within the National Spinal Injuries Centre for the Prevention of Pressure Sores, E.C. Rogers; Paraplegia, 16(2):147-154, Aug. 1978.

An Optimality Criterion for Processing Electromygraphic (EMG) Signals Relating to Human Locomotion, C. Hershler and M. Milner; IEEE Trans. on Biomed. Engng., 25(5):413-421, Sept. 1978.

Personal Licensed Vehicles for the Disabled, Report of a Workshop held June 14-17, 1976. Publ. 1977, 191 pp, $5.00, Rehabilitation Engineering Center, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pa. 19141.

Power Reclined Wheelchair Back, W.D.S. Brereton and R. Thornhill; J. of Med. Engng. & Tech., 2(6):315-316, Nov. 1978.

Real Time Correlator for Detecting Single Units in Peripheral Nerve, F.J. Looft, III and W.J. Heetderks; IEEE Trans. on Biomed. Engng., BME-25(6):564-567, Nov. 1978.

Recording from a Single Motor Unit During Strong Effort, S. Andreassen and A. Rosenfalck; IEEE Trans. on Biomed. Engng., BME-25(6):501-509, Nov. 1978.

Reflections on Training in Orthopaedic Techniques, W. Krieger; Pros. & Ortho. Int'nl., 2(3):118-121, Dec. 1978.

Rehabilitation Engineering as the Crow Flies — Part IV, J. Foort, R. Hannah, and S. Cousins; Prosth. & Ortho. Int'nl., 2(2):81-86, Aug. 1978.

Rehabilitation Engineering as the Crow Flies — Part V, J. Foort, R. Hannah, and S. Cousins: Prosth. & Ortho. Int'nl., 2(3):157-161, Dec. 1978.

Rehabilitation Engineering — A Growing Part of the Rehabilitation Services, K. Montan; Prosth. & Ortho. Int'nl. 2(2):111-114, Aug. 1978.

Reporting the Handicapped Driver, S. Jacobs; Arch. Phys. Med. Rehab., 59:387-390, Aug. 1978.

The Shoulder Complex in Elevation of the Arm: A Mechanism Approach, Z. Dvir and N. Berme; J. Biomechan., 2:219-225, 1978.

Significant Events in the Rehabilitation Process: The Spinal Cord Patient's Point of View, Norman C. Lawson; Arch. of Phys. Med. and Rehab., 59(12):573, Dec. 1978.

Significant New Observations on Cervical Spine Trauma, M.D. Miller, J.A. Gehweiler, S. Martinez, et al.; Orthop. Surv., 2(1):45-47, Aug. 1978.

A Simple Model of Step Control in Bipedal Locomotion, J.M. Morawski; IEEE Trans. on Biomed. Engng., BME-25(6):544-550, Nov. 1978.

Simpson-Edinburgh Low-Pressure Air Bed: An Early Clinical Evaluation, E. McClemont, D.C. Simpson, K.J. McCubbin, et al.; Paraplegia, 16(2):154-160, Aug. 1978.

Survival and Ambulation Following Hip Fracture, C.W. Miller; J. of Bone & Joint Surg., 60-A/7:930-934, Oct. 1978.

Synchronization of Respiratory Rhythm with Electrical Stimulation of the Phrenic Nerve, M. Noshiro and S. Suzuki; IEEE Trans. on Biomed. Engng., BME-25(6):550-554, Nov. 1978.

Synthetic-Membrane Technology, H.P. Gregor and C.D. Gregor; Scientific American, 112-131, July 1978.

A System for Clinically Evaluating Wheelchair Pressure-Relief Cushions, S.L. Garber, T.A. Krouskop, and R.E. Carter; Amer. J. of Occup. Ther., 32(9):565-571, Oct. 1978.

Technical Aids, E. Peizer, Prosth. & Ortho. Int'nl., 2(2):105-111, Aug. 1978.

Thixotrophy in Human Skin, J.B. Finlay; J. Biomech., 11(6/7):333-343, 1978.

Treatment of Orthopaedic Infections with Electrically Generated Silver Ions, R.O. Becker and J.A. Spadaro; J. Bone & Joint Surg., 60-A/7:871-882, Oct. 1978.

Use of Surface Electromyogram as a Measure of Dynamic Force in Human Limb Muscles, P.A. Crosby; Med. & Bio. Engng. & Comput., 16(5):519-525, Sept. 1978.

A Variable Axis Electrogoniometer for the Measurement of Single Plane Movement, J.A. Tata, A.O. Quanbury, T.G. Steinke, and R.E. Grahame; J. of Biomech., 11(8/9):421-427, Aug. 1978.

Variability and Biomechanics of Synergy Patterns of Some Lower-Limb Muscles During Ascending and Descending Stairs and Level Walking, M.A. Townsend, S.P. Lainhart, R. Shiavi, and J. Caylor; Med. and Bio. Engng. & Comput., 16(6):681-689, Nov. 1978.

Workshop on Wheelchairs—1977, Report on a Workshop held Dec. 6-9, 1977, $5.00, Rehabilitation Engineering Center, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pa. 19141.

CALENDAR OF EVENTS

Biomechanics Symposium in Connection with the ASME 1979 Summer Applied Mechanics/Bioengineering/Fluids Engineering Conference (co-sponsored by the Canadian Society for Mechanical Engineering), Niagara Falls, N.Y., June 18-20, 1979. (For information: Albert B. Schultz, University of Illinois at Chicago, Department of Materials Engineering, Box 4348, Chicago, Illinois 60680).

8th Congress of the World Federation of the Deaf, Varna, Bulgaria, June 20-26, 1979. (For information: Secretariat General, Union of the Deaf of Bulgaria, 3 Bd Ul Zaimov, Sofia, Bulgaria.)

Conference on Biomechanics of Movement, New England College, Henniker, New Hampshire, June 24-29, 1979. (For information: Engineering Foundation, 345 East 47th Street, New York, N.Y. 10017, Tel (212) 644-7835)

American Physical Therapy Association, Annual Conference, Atlanta, Georgia, June 25-29, 1979. (For information: APTA, 1156 15th St., N.W. Washington, DC. 20005.)

5th World Conference on the Theory of Machines and Mechanisms, Montreal, Canada, July 8-13, 1979. (For information: Canadian Council of the International Federation of Theory of Machines and Mechanisms, in cooperation with the USCTOMM.)

Japan Society of Medical Electronics and Biological Engineering, 18th Annual Conference, Tokyo, Japan, July 1979 (exact dates not available). (For information: K. Ikeda, Japan Society of Medical Electronics and Biological Engineering, Tokyo, Japan.)

The Paralyzed Veterans of America, International Disabled Expo, Astrohall, Houston, Texas, Aug. 2-4, 1979. (For information: R.J. Powell, General Manager, 32 W. Randolph St., Chicago, Ill. 60601, Tel. (312) 346-0752.)

4th Congress of the International Society of Electrophysiological Kinesiology, Boston, Mass., Aug. 5-10, 1979. (For information: Carlo J. De Luca, Ph.D., Children's Hospital Medical Center, 300 Longwood Avenue, Boston, Mass. 02115.)

1st International Conference on First Aid at the Scene of an Accident, Oslo, Norway, Aug. 7-11, 1979. (For information: Norwegian Automobile Assn., Box 494, Oslo 1, Norway.)

33rd National Convention of the Blinded Veterans Association, Los Angeles, Ca., Aug. 7-11, 1979. (For information: BVA, 1735 DeSales Street, Wash. D.C. 20036.)

12th International Conference on Medical and Biological Engineering/International Conference on Medical Physics, Jerusalem, Israel, Aug. 19-24, 1979. (For information: Dr. A. Werner, Chaim Sheba Medical Center, Dept. of Oncology, Sackler School of Medicine, Tel-Hashomer, Israel, Kenes Box 16271, Tel Aviv, Israel.)

Interagency Conference on Rehabilitation Engineering, Atlanta Hilton, Atlanta, Georgia, Aug. 26-31, 1979. (For information: CMC, 6041 Windhover Drive, Orlando, Florida 32805, Tel. (305) 351-2592.)

7th International Ergonomics Association Conference, Warsaw, Poland, Aug. 27-31, 1979. (For information: Prof. J. Rosner, UL Gornoslaka 20, 00-484, Warsaw, Poland.)

5th International Symposium on Bioelectrochemistry and Bioenergetics, Weimar, German Democratic Republic, Sept. 3-8, 1979. (For information: Prof. Dr H. Berg, Zentralinstitut für Mikrobiologie und experimentelle Therapie der Academie der Wissenschaften der DOR, DDR-69 Jena, Beuthenbergstrabe 11.)

7th International Congress of Biomechanics (Biomechanics-79), Warsaw, Poland, Sept. 18-22, 1979. (For information: Inst. Sportu, Ceglowska 68/70, 01-809, Warszawa, Poland.)

6th World Assembly of the World Council for the Welfare of the Blind, Kaduna, Nigeria, Oct. 3-12, 1979. (For information: WCWB, 58 Avenue Bosquet, Paris 75007, France.)

32nd Annual Conference on Engineering in Medicine and Biology (ACEMB), Denver Hilton, Denver, Colo., Oct. 6-10, 1979. (For information: Patricia I. Horner, Suite 404, 4405 East-West Highway, Bethesda, Maryland 20014, Tel. (301) 657-4142.)

Optical Society of America (OSA), Annual Meeting, Holiday Inn/Americana Flagship Hotel, Rochester, New York, Oct. 7-12, 1979.

American Society for Testing and Materials (ASTM), Symposium on Footwear and Safety, McCormick Inn, Chicago, Ill., Oct. 16-17, 1979. (For information: ASTM, 1916 Race St., Philadelphia, Pa. 19103.)

American Orthotic and Prosthetic Association (AOPA), National Assembly, Washington, D.C., Oct. 23-27, 1979. (For information: 1444 N Street, N.W., Washington, D.C. 20005, Tel. (202) 234-8400.)

American Academy of Maxillofacial Prosthetics, Annual Meeting, Grand Hotel, New Orleans, La., Oct. 27-31, 1979. (For information: J.W. Schweiger, D.D.S., Maxillofacial Prosthetics Center, VA Medical Center, Wilmington, Delaware 19805.)

American Academy of Physical Medicine and Rehabilitation and American Congress of Rehabilitation Medicine Convention, Honolulu, Hawaii, Nov. 11-16, 1979.

American Speech and Hearing Association (ASHA), Annual Meeting, Atlanta, Georgia, Nov. 16-19, 1979.

Acoustical Society of America, Salt Lake City, Utah, Nov. 26-30, 1979.

3rd International Congress on Improving the Quality of Life of the Handicapped with Assistive Devices, Nov. 1979. (For information: World Veterans Federation, 16 Rue Hamelin, Paris, France.)

American Corrective Therapy Association, Annual Meeting, Portland, Oregon, 1979. (For information: Dept. of Corrective Therapy, Dr. Oral Mathison, VA Medical Center, Battle Creek, Michigan, Tel. (616) 372-3281.)

American Occupational Therapy Association, Annual Meeting, Denver, Colorado, 1979.

Latin American Association for Rehabilitative Medicine (AMLAR), Guatemala, 1979.

2nd International Symposium for Facial Prostheses, England, 1979. (Note; this is the tentative re-scheduling of a meeting announced for May 4-6, 1978, and cancelled.)

American Society of Mechanical Engineers (ASME), Statler Hilton Hotel, New York, New York, Dec. 2-7, 1979. (For information: ASME, 345 E. 47th St., New York, N.Y. 10017, Tel. 212-644-7772.)

American Association for the Advancement of Science (AAAS), 146th Annual Meeting, San Francisco, Calif., Jan. 3-8, 1980. (For information: Meeting Office, AAAS, Washington, D.C.).

American Academy of Orthopaedic Surgeons (AAOS), Atlanta, Georgia, Feb. 7-12, 1980.

20th Anniversary and 10th International Conference on Recent Advances in Biomedical Engineering, London, England, Mar. 23-29, 1980. (For information: K. Copeland, Biological Engineering Society, London, England.)

1st World Biomaterials Congress, Baden (near Vienna), Austria, Apr. 8-12, 1980. (For information: World Biomaterials Congress, Secretariat, Mrs. E. Maurer, Medical Academy of Vienna, Alser StraBe 4, A-1090 Vienna, Austria.)

3rd International Congress on "Improving the Quality of the Handicapped Person's Community Life: Today and Tomorrow," Houston, Texas, April 27-May 2, 1980. (For information: Prof. William A. Spencer, Texas Institute for Rehabilitation and Research, Texas Medical Center, 1333 Moursund Avenue, Houston, Texas 77030, Tel. (713) 797-1440.)

8th International Congress of Disability Prevention and Medical Rehabilitation, sponsored by the International Federation of Physical Medicine and Rehabilitation, Stockholm, Sweden, May 23-27, 1980. (For information: Dr. U. Moritz, Sydsvenska Sjukgymnastinst, S-220 05, Lund 5, Sweden.)

Interagency Conference on Rehabilitation Engineering, Sheraton Centre, Toronto, Canada, June 15-20, 1980. (For information. (CMC, 6041 Windhover Drive, Orlando, Florida 32805.)

Alexander Graham Bell Association for the Deaf, Biennial Convention, Shamrock Hilton Hotel, Houston, Texas, June 23-27, 1980.

Helen Keller Congress—Blueprint for the Future, Boston, Massachusetts, June 23-28, 1980. (For information: American Foundation for the Blind, Inc., 15 West 16th Street, New York, N.Y. 10011.)

14th World Congress of Rehabilitation International, Winnipeg Convention Centre, Winnipeg, Canada, June 20-27, 1980. (For information: 14th World Congress of Rehabilitation International c/o Canadian Rehabilitation Council for the Disabled, Box 1980, Winnipeg, Manitoba, Canada R3C3R3.

8th Annual New England Bioengineering Conference, Cambridge, Mass., Spring 1980. (For information: IEEE, 345 East 47 Street, New York, New York 10017.)

Medical Devices and Sporting Equipment Committee of the Design Engineering Division, International Conference, Aug. 18-21, 1980, San Francisco, Ca. (For information: Dr. Terry E. Shoup, Mech. Engrng. Dept., Universtiy of Houston, Houston, Texas 77004. Tel. (713) 749-4459.)

American Orthotic and Prosthetic Association, (AOPA) New Orleans, La., September 1980. (For information: 1444 N Street, N.W., Washington, D.C. 20005, Tel. (202) 234-8400.)

2nd Mediterranean Conference on Medical and Biological Engineering, Marseilles, France, Sept. 1980. (For information: Prof. G. Kaplan, Laboratoire de Physique, Faculte de Medecine (Nord), Boulevard P-Drummard, 13326 Marseilles Cedex III, France.)

33rd Annual Conference on Engineering in Medicine and Biology (ACEMB), Washington Hilton Hotel, Washington, D.C., Sept. 27-Oct. 1, 1980.

3rd World Congress of the International Society for Prosthetics and Orthotics (ISPO), Bologna, Italy, Sept. 28-Oct. 4, 1980. (For information: Secretariat Åse Larsson, ISPO, P.O. Box 42, 2900 Hellerup, Denmark.)

American Speech and Hearing Association (ASHA), New Orleans, La., Nov. 21-24, 1980.

(Tentative) American Orthotics and Prosthetics Association (AOPA), National Assembly, Toronto, Ontario, Canada, 1980. (For information: 1444 N Street, N.W. Washington, D.C. 20005, Tel. (202) 234-8400.)

4th World Congress of the International Rehabilitation Medicine Association, Stockholm, Sweden, 1980. (For information: International Rehabilitation Medicine Association, CH-7310, Bad Ragaz, Switzerland.)

Interagency Conference on Rehabilitation Engineering, Washington, D.C., 1981 (Tentative), (For information: CMC, 6041 Windhover Drive, Orlando, Florida 32805.)

INDEX TO THE BULLETIN OF PROSTHETICS RESEARCH

A brief explanation of the index follows: The index covers BPR 10-21 Spring 1974 through 10-30 Fall 1978 of the Bulletin of Prosthetics Research. The notation "10-21 (25-50)" is the style used to reference the item; i.e., "10-21" designates the BPR issue numerically, and "(25-50)" denotes the pages of that particular entry. Natural language vocabulary is used.

A

Abbey Rents, Los Angeles, California
- — A-BEC Electric Wheelchair, (British Electric Co.) VAPC Research Report 10-24(180-182) 10-25(145)

Above-Elbow Prostheses and Components
- -- Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses *see* Above-Elbow Prosthetics Research
- — The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients With Myoelectric Control: Hannes Schmidl 10-27(17-42)
- — The Lift Lock: A Device to Increase the Lifting Ability of Dual-Control Prostheses: Lawrence E. Carlson and Dudley S. Childress 10-23(158-168)
- — Position Control of Above-Elbow Prostheses. Contractor Reports: L. E. Carlson (University of Colorado, Boulder, Colorado) 10-29(108-109) 10-30(184-185)
- — Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior and Charles M. Scott 10-24(43-50)

Above-Elbow Prosthetics Research
- — Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses
  - — Contractor Reports: J.H. Lyman, A. Freedy, and R. Prior. University of California, Los Angeles, School of Engineering and Applied Science, Biotechnology Laboratory, Los Angeles, California 10-21(122-123) 10-23(284-285) 10-24(219-220) 10-25(184-194) 10-26(286-288) Moshe Solomonow 10-27 (129-132) 10-28(139-141) 10-29(104-106) 10-30(179-181)
- — A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals Using Microprocessors: Daniel Graupe, Alosius A.M. Beex, William J. Monlux, and Ian Magnussen 10-27(4-16)

— *See also* Control of an Artificial Upper-Limb Prosthesis in Several Degrees of Freedom (Contractor Report)
— Prosthetics Research. Contractor Report: Robert G. Thompson and Dudley S. Childress (Northwestern University)
— Above-Elbow Prosthesis Control (Subconscious Control via "Extended Physiological Proprioception") 10-27(128) 10-28(135)
— Above-Elbow Prostheses Devices 10-23(283-284)
— Atmospheric Pressure Suspension Systems for Above-Elbow Amputees 10-27(129) 10-30(177)
— Design of a Powered Arm for Shoulder Disarticulation Amputees 10-26(285) 10-28(135) 10-29(100-101) 10-30(176-177)
— A Search for Better Limbs: Prosthetics Research at Northwestern University: Dudley S. Childress, John N. Billock, and Robert G. Thompson
— Glenohumeral Joint 10-22(207-208)
— Harness for the Above-Elbow Amputee 10-22(205-206)
— Lift-Lock Mechanism 10-22(206-207)
— Self-Contained and Self-Suspended Devices 10-22(204)
— Short Above-Elbow Prosthesis. Contractor Reports: W. Seamone and G. Schmeisser, Jr. (Johns Hopkins University) 10-21(130-132)

Above-Knee Endoskeletal Structures
— VAPC Research Report 10-26(217-218)

Above-Knee Prostheses
— A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W. R. Dyck, S. Onyshko, D. A. Hobson, D. A. Winter, and A. O. Quanbury 10-23(169-186)
— *see also* Hip, Hip Joint, Knee, Knee Joint, Lower-Limb Prostheses Hydraulic Control Systems

Abstracts
— Readers are Invited to Contribute Voluntary Abstracts of New Books and Articles of Interest to BPR Readers. Notes and News 10-30(280)

Academy of Maxillofacial Prosthetics
— Dr. John F. Lontz Honorary Fellow of Academy of Maxillofacial Prosthetics. Notes and News 10-30(284-285)

Acceleration of Bone Healing by Electrical Stimulation
— Contractor Reports: G.V.B. Cochran. St. Luke's Hospital, New York, N.Y. 10-21(141-142) 10-22(VA Conference Report 291-294) 10-23(315-318) 10-24(238-239) Helen Hayes Hospital, West Haverstraw, N.Y. 10-25(208-209) 10-26(322 no report) 10-27(157-158) 10-28(179-180) 10-29(136) 10-30(209)
— *See also* Evaluation of Electrical Stimulation Techniques for Stimulation of Hard Tissue Growth

Acoustical Society of America
— Meeting. Calendar of Events 10-23(365, 366) 10-24(292, 293) 10-25(265, 266) 10-26(384, 386) 10-27(216, 217) 10-28(264) 10-29(201, 202) 10-30(300)
Accurate Knitting Mills, Inc.
— Stump Sock Compliance Testing 10-23(260)
Action Products, Inc., Olean, N.Y.
— Action No. 6000 Bed Pad. VAPC Research Report 10-26(251-253)
Actuator Device for Artificial Leg
— Recent Patents: John L. Burch 10-27(208)
Acuity
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Visual Acuity 10-26(81-82)
Adapted VAPC Hospital Environmental Control System for Home Use
— VAPC Research Report 10-28(100)
Adaptive Automotive Controls and Equipment *see* Automotive Driving Aids
Adaptive Automotive Equipment Manufacturers in Compliance with VA Document VAPC A-7505-8
— VAPC Research Report 10-25(168)
Adjustable Folding Walker
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Walkers 10-30(70-75)
Adjustable Knee-Ankle-Foot and Ankle-Foot Orthosis, (KAFO and AFO)
— VAPC Research Report 10-23(225-226)
Adjustable Leg Brace
— Recent Patents: Robert L. Konvalin 10-24(284)
Adjustable Wheelchairs
— Recent Patents: Andrew Karchak, Jr. and James R. Allen 10-25(257)
Administrative Aspects (VA Conference of Prosthetics and Sensory Aids): Eugene F. Murphy 10-22(487)
Adult Powered Tricycle
— VAPC Research Report 10-28(113)
Advanced Automotive Adaptive Equipment, Development and Evaluation
— Contractor Reports: M. McDermott, Jr., and L.A. Leavitt (Texas A&M University College of Engineering, College Station, Texas) 10-25(205-206) 10-26 (317-320) 10-27(149-154)
Advanced Orthotic Devices for Adult Paraplegics, Research and Development Project

— Contractor Reports: M.T. Prast (Prast Research Associates, Grand Island, New York) 10-24(254-256) L.E. Carlson. (University of Colorado, Boulder, Colorado) 10-25(215) 10-26(340-341) 10-27(169-172) 10-28(195) 10-29(132 no report) 10-30(206)
— Goals for the Future 10-27(171-172)
— The PACO Concept (Pivot Ambulating Crutchless Orthosis) 10-27(169)
Advanced Wheelchair
— VAPC Research Report 10-21(97-98)
Adventitiously Blind
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Benefits from ETA's 10-30(78)
Advisory Panel for Evaluation of the Laser Cane, 1971, 1974
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Evaluation (C-4 Laser Cane) 10-30(90)
— Functions Performed by ETA's 10-30(77-78)
AEMB Elects New Officers for 1978-79
— Notes and News 10-29(188)
AEMB *see* Alliance for Engineering in Medicine and Biology
AFO *see* Ankle-Foot Orthosis
Aids and Appliances for the Blind and Visually Impaired
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Specifications 10-30(48-49)
— *See also* Mobility Aids for the Blind, Reading Machines, Sensory Aids, Workshop on Low Vision Mobility
Aids to Daily Living
— APOR Safety Shower and Tube Guard. VAPC Research Report 10-30(147–148)
— Bailey III Cushion Grip Tape. VAPC Research Report 10-28(125-126)
— E-Z Reacher #201. VAPC Research Report 10-23(250-251)
— Gyro-Gym Therapeutic Exerciser. VAPC Report 10-26(262-263)
— Handi-Cup. VAPC Research Report 10-30(147)
— Porta-Care Sink. VAPC Research Report 10-30(145-146)
— Portable Inflatable Bathtub. VAPC Research Report 10-30(146-147)
— Sydnor Feeder. VAPC Research Report 10-26(261-262)
— Winsford Feeder. VAPC Research Report 10-28(126-127)
Aids to Daily Living
— *see also* Manipulators
Alarm Systems for the Handicapped *see* Environmental Control and Communication Systems
The Alexander Graham Bell Association for the Blind
— Biennial Convention. Calendar of Events 10-28(264)
— National Convention. Calendar of Events 10-23(365) 10-24(292)

Alignment Device for Artificial Limbs
— Recent Patents: Denis R.W. May 10-29(195)
Ali, Nazir A.
— Laser Cane Blind Mobility Aid. Contractor Reports: J.M. Benjamin, Jr., N.A. Ali, and D.R. Bolgiano (Bionic Instruments, Inc., Bala Cynwyd, Pennsylvania) 10-23(330-331) 10-24(256 no report) 10-25(215 no report)
Allen, James R.
— Adjustable Wheelchairs. Recent Patents 10-25(257)
— Bed Chair. Contractor Reports: J. Perry and J.R. Allen (The Professional Staff Association of the Rancho Los Amigos Hospital Downey, California) 10-21(150)
— Mobile Bed/Chair for High Level Quadriplegics. Contractor Reports: J. Perry and J.R. Allen (The Professional Staff Association of the Rancho Los Amigos Hospital, Downey, California) 10-23(329 no report) 10-24(253 no report) 10-26(334-339)
— Mobile Bed/Wheelchair Development: J. Perry and J. Allen 10-22(370-376)
— Wheelchair Drive Package. Recent Patents 10-25(258)
Alliance for Engineering in Medicine and Biology
— AEMB Elects New Officers. Notes and News 10-24(278-279)
— Dr. Weller Re-Elected President of AEMB. Notes and News 10-26(369-370)
— *see also* Conference on Engineering in Medicine and Biology
Alson, Lola
— Wheelchair Assembly and Body-Supporting Insert Therefor. Recent Patents 10-22(529)
AMBRDL (Army Medical Bioengineering Research and Development Laboratory) Microsphere Mattress
— VAPC Research Report 10-24(194-196)
AMBRDL Random Access Environmental Control
— VAPC Research Report 10-25(140-142)
Ambulation System
— Parapodium for Adult Paraplegics: Martin T. Prast 10-22(391-403)
Ambulators
— Jouk Power-Aid Ambulator, VAPC Research Report 10-24(185-187)
Ambulift
— VAPC Research report 10-26(255-256) 10-30(137)
American Academy of Maxillofacial Prosthetics
— The First International Symposium On Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
American Academy of Orthopaedic Surgeons

— Annual Meeting. Calendar of Events 10-27(217) 10-28(265) 10-21(186) 10-23(365) 10-25(266) 10-27(217) 10-28(265, 266) 10-29(201, 203) 10-30(299, 301)
American Academy of Physical Medicine and Rehabilitation, and American Congress of Rehabilitation Medicine
— Convention. Calendar of Events 10-21(186) 10-26(385, 386, 387) 10-27(216, 217, 218) 10-28(265, 266) 10-29(201, 202) 10-30(300)
American Association for the Advancement of Science
— AAAS Project on the Handicapped in Science Employs Cheryl A. Davis and Receives $185,000 in Grants. Notes and News 10-28(248)
— AAAS Sponsors "Project for the Handicapped in Science." Notes and News 10-25(249)
— 144th National Meeting. Calendar of Events 10-27(217)
American Association of Physicists in Medicine
— Annual Meeting. Calendar of Events 10-26(385)
American Association of Workers for the Blind. Calendar of Events 10-26(385)
American Congress of Rehabilitation Medicine
— Conference. Calendar of Events 10-24(293, 294) 10-25(265, 267)
— *see also* American Academy of Physical Medicine
American Corrective Therapy Association
— Annual Meeting. Calendar of Events 10-26(384) 10-28(264) 10-29(203) 10-30(300)
American Foundation for the Blind
— Established an English Edition of Book on the EEG's of Blind Persons. Notes and News 10-22(577)
— Loyal E. Apple Appointed New AFB Executive Director. Notes and News 10-22(525-526)
— Published New "Journal of Blindness and Visual Impairment." Notes and News 10-26(373)
— To Publish "Foundations of Orientation and Mobility." A Chapter, "Mobility Devices", by Leicester W. Farmer, is pre-printed in BPR 10-30(47-118)
American Institutes for Research (AIR), Palo Alto, California
— Evaluation Procedures for Environmental Sensing, Orientation and Mobility by the Blind. Contractor Reports: R.A. Weisgerber 10-25(233-236)
— The Reading of Printed Materials by the Blind. Contractor Reports: R.A. Weïsgerber 10-21(167-170) 10-23(346-348) 10-24(269-270) B.E. Everett, C.A. Smith 10-25(236-238)
American Medical Association
— Annual Convention. Calendar of Events 10-26(384)
American Occupational Therapy Association
— Annual Conference. Calendar of Events 10-25(265) 10-26(385)

10-27(216) 10-28(265) 10-29(202, 203) 10-30(299, 301)
American Orthopaedic Association
— Annual Meeting. Calendar of Events 10-22(537) 10-26(384) 10-28(264)
American Orthopaedic Foot Society
— Annual Meeting. Calendar of Events 10-26(385) 10-27(217)
American Orthotic and Prosthetic Association (AOPA)
— National Assembly. Calendar of Events 10-21(186) 10-22(537, 538) 10-24(293, 294) 10-25(265, 266, 267) 10-26(385, 386, 387) 10-27(216, 217, 218) 10-28(265, 266) 10-29(201, 202, 203) 10-30(300, 301)
American Physical Therapy Association
— Annual Conference. Calendar of Events 10-21(186) 10-22(537) 10-23(365, 366) 10-24(292, 293) 10-25(266) 10-26(384) 10-28(266) 10-29(202) 10-30(299)
The American Prosthodontic Society
— The First International Symposium On Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
American Society of Biomechanics
— Notes and News 10-25(253)
— Second Annual Meeting. Calendar of Events 10-28(265) 10-29(201)
American Society of Mechanical Engineers (ASME)
— 15th Biennial Mechanisms Conference. Calendar of Events 10-28(265)
— Summer Applied Mechanics Conference. Calendar of Events 10-22(537) 10-29(202) 10-30(299)
— Winter Annual Meeting. Calendar of Events 10-22(537) 10-25(265, 267) 10-26(385, 387) 10-27(216, 217, 218) 10-28(265, 266) 10-29(201, 202) 10-30(300)
American Society of Mechanical Engineers (ASME) *see also* Conference on Engineering in Medicine and Biology
American Society for Testing and Materials (ASTM)
— ASTM Forms Committee on Orthotics and External Prosthetics Notes and News 10-22(522)
— Symposium on Footwear and Safety. Calendar of Events 10-30(300)
American Speech and Hearing Association (ASHA)
— Annual Meeting. Calendar of Events 10-22(357, 358) 10-23(365, 366) 10-24(293, 294) 10-25(265, 266, 267) 10-26(385, 386, 387) 10-27(216, 217) 10-28(265, 266) 10-29(201, 202, 203) 10-30(301)
American Stair Glide Corp., Grandview, Missouri
— Electric Wheelchair 10-26(228-229)
— Manufacturer, Freewheeler Power Wheelchair 10-29(85-86)

Amigo, Inc., Bridgeport, Michigan
— Amigo Tri-Wheel Motorized Wheelchair 10-27(107-108)
Amigo Motorized Wheelchair
— VAPC Research Report 10-27(107-108)
Amplitude Compression
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. A Final Report: Raymond T. Carhart and Lamar Young 10-26(9-45)
— The Effects of Amplitude Compression on Speech Intelligibility 10-26(31-40)
Amputation Level
— Amputation Level Determination 10-22(105-108)
— Below-Knee Amputation With Immediate Postoperative Fitting of Prosthesis. Contractor Reports: W.S. Moore, A.D. Hall, and L.A. Wilson (VA Hospital, San Francisco, California) 10-21(128) 10-23(300) 10-24(225, no report) 10-25(200, no report) 10-26(307) 10-27(142, no report) 10-28(156, no report) (VA Hospital, Tucson, Arizona) 10-29(124-125) 10-30(199)
— Hemodynamic Evaluation of Postoperative and Preoperative Amputees. Contractor Reports: Bok Y. Lee, F.S. Trainor, J.L. Madden, E. Ejercito 10-21(142-143) 10-23(318-319) 10-24(239-240) D. Kavner 10-25(209-210) 10-26(322-323) 10-27(158-161) 10-28(180-181) 10-29(125-127) 10-30(199-200)
— Above-Knee Amputations 10-30(200)
— Below-Knee Amputations 10-30(200)
— Conclusions 10-29(127)
— The Efficacy of Lumbar Sympathectomy in the Treatment of Gangrene of the Lower Limb 10-29(125-127)
— Non-Invasive Techniques as an Aid to Determination of Amputation Level 10-30(199)
— Hemodynamic Evaluation in Selection of Amputation Level: Bok Y. Lee 10-22(85-104)
— The Importance of Amputation-Level Determination. Guest Editorial: Wesley S. Moore 10-28(1-3)
— Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior and Charles M. Scott 10-24(43-50)
— Background 10-24(43-46)
Amputation Level *see also* Skin Blood Flow
Amputation Surgery
— Amputation Surgery and Prosthetics: Eugene F. Murphy 10-22(79-84)
— A Sensory Feedback System for an Upper-Limb Amputation Prosthesis: Frank W. Clippinger, Roger Avery, and Bert R. Titus 10-22(247-258)

— Surgery as Related to Prosthetics and Orthotics: Ernest M. Burgess 10-22(15-21)
— *See also* Postsurgical Wound Management
Amputee-Prosthesis Interface
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Socket and Harnessing 10-30(21-23)
— *See also* Socket Pressure
Amputees
— Civilian (Predominantly Geriatric) Amputees Contrasted with Veteran Amputees at VA Prosthetics Center Clinic; VAPC (Clinic Team) Research Report 10-25(173-177)
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
— Selection of Amputee Subjects 10-24 (60-65)
— Clinical Evaluation of a Sensory Feedback Device: the Limb Load Monitor. Gunilla Wannstadt and Rebecca L. Craik 10-29(8-49)
— Types of Treatment Approaches and Modes of Device Feedback Used for Amputation and Hemiplegia Patients (graph) 10-29(23)
— A Kneeless Leg Prosthesis for the Elderly Amputee, Advanced Version: Rahamin Seliktar and R.M. Kenedi 10-25(97-119)
— A Proposed Technique for the Post-operative Monitoring of Skin Tension in Below-Knee Amputees: Ernest M. Burgess, Craig A. Spolek, and A. James Moore, Jr. 10-28(4-15)
— Analysis 10-28(12-14)
— Background 10-28(5-6)
— Biomechanical Model 10-28(6-7)
— Suturing-In the Strain Gage 10-28(11-12)
— A Survey of Lower-Limb Amputees: Prostheses, Phantom Sensations, and Psychosocial Aspects: Bernice Kegel, Margaret L. Carpenter, and Ernest M. Burgess 10-27(43-60)
— Materials and Methods of the Survey 10-27(44)
— References 10-27(60)
— Results 10-27(44-60)
— Patient Sample 10-27(44–46)
— Prosthetic Information 10-27(46–53)
— Psychosocial Aspects of Amputation 10-27(53–56)
Amputees
— *see also* Lower-Limb Amputees
Amputee's Manual . . . Mauch S-N-S Knee

— Notes and News 10-28(251)
Anderson, David M.
— Universal Wheelchair for the Severely Disabled. Recent Patents 10-24(286)
"... And I Say to You Tonight That the Time for Discrimination Against the Handicapped ... is Over" —*President Carter*
— Notes and News 10-28(249-250)
Angle Adjustment Unit for Prostheses and Orthoses
— Recent Patents: Franz.Gelbenegger 10-22(528)
Animal Models
— Skeletal Extension Development: Criteria for Future Designs: Charles William Hall, P. A. Cox, and William A. Mallow 10-25(69-96)
— Animal Models and Surgical Procedures 10-25(79-81)
Ankle
— Ankle Block
— Recent Patents: Cecil T. Benton, John M. Freter, and Robert R. Moore 10-26(375)
— Ankle-Foot Orthoses (AFO)
— VAPC Functional Equino-Varus Ankle-Foot Orthosis, 10-24(160–162)
— Ankle Joints
— Electrical Stimulation of Limbs: Part III. Joint Position Control: Alain Fournier, Etienne Dombre, and Philippe Coiffet 10-25(5-24)
— Ankle Wrap
— Recent Patents: Ignatius F. Castiglia 10-30(287)
Annual Conference on Engineering in Medicine and Biology (ACEMB) *see* Conference on Engineering in Medicine and Biology
Antagonist Forces
— Electrical Stimulation of Limbs: Part III. Joint Position Control: Alain Fournier, Etienne Dombre, and Philippe Coiffet 10-25 (5-24)
— Determination of the Antagonists' Effects 10-25(9-10)
APL (Applied Physics Laboratory, Johns Hopkins Univ.) Electric Prosthesis
— VAPC Research Report 10-21(74-77)
— *see also* Johns Hopkins, Manipulators
APOR Industries, Inc., Aurora, Ohio
— APOR Safety Shower and Tub Guard 10-30(147-148)
APOR Safety Shower and Tub Guard
— VAPC Research Report 10-30(147)
Apparatus to Assist Fastening of an Artificial Limb
— Recent Patents: Frank Bianco 10-25(259)

Apparatus for Connecting a Prosthesis to a Bone
— Recent Patents: Lester J. Owens 10-26(375)
Apparatus for the Identification of Size Numbers of Right and Left Shoe Lasts
— Recent Patents: Ludvik Dokoupil Oldrich Hrouda, and Josef Zila 10-30(287)
Apparatus for Promoting Healing Processes
— Recent Patents: Werner Kraus 10-25(257)
Applegate, Leslie T.
— Hinge for Knee Brace. Recent Patents 10-30(288)
Applegate, William R.
— Functional Ankle for a Prosthetic Limb. Recent Patents 10-29 (195)
Apple, Loyal E.
— Appointed New AFB Executive Director. Notes and News 10-22 (525-526)
— Current State of the VA Research Effort at the Western Blind Rehabilitation Center: L.E. Apple 10-22(458-462)
— Experience with Closed Circuit Television in the Blind Rehabilitation Program of the Veterans Administration: Edwin B. Mehr, Alan B. Frost, and Loyal E. Apple 10-21(54-68)
— Mobility and Reading Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports: L.E. Apple, Richard Bennett, William Ekstrom, and Donald C. Cooper, (Western Blind Rehabilitation Center, VAH, Palo Alto, California) 10-21(163-165)
— Workshop on Low Vision Mobility: L.E. Apple and B.B. Blasch 10-26(46-138)
Appliance for Foot Orthosis
— Recent Patents: Mario DiGiulio 10-30(287)
APRL (Army Prosthetics Research Laboratory) Voluntary Closing Hook (Compliance Testing)
— VAPC Research Report 10-27(117) 10-30(174)
Architectural Barrier-Free Designs
— Bibliography Published on Architectural Barrier-Free Designs for the Handicapped. Notes and News 10-22(524)
Arm Prostheses *see* Upper-Limb Prostheses
Arnhem, the Netherlands
— The First International Symposium On Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
Arrigo, Michael F.
— Method of Making a Permanent Prosthetic Socket. Recent Patents 10-24(285)

Arrow Wheelchair
— VAPC Research Report 10-29(90-93)
Arroyo, Ronald
— Control and Communication Devices for the Severely Disabled: R. Arroyo 10-25(55-68)
Arthur L. Castor, Inc., Compton, Calif.
— Castor Portable Standing Frame 10-30(133-134)
Articulated Master Slave Manipulator
— Recent Patents: Carl R. Flatau 10-27(208)
Articulate Joint for Prosthetic Devices
— Recent Patents: Richard Glabiszewski 10-26(375)
Artifact Signals
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Data Treatment and Analysis 10-30(13-19)
Artificial Arms *see* Upper-Limb Prostheses, Upper-Limb Prosthetics
Artificial Foot
— Physical Response of SACH Feet Under Laboratory Testing: R.L. Daher 10-23(4-50)
— *See also* SACH Feet, Feet Lower-Limb Prosthetics
Artificial Foot
— Recent Patents: John L. Orange 10-21(177)
Artificial Foot Having Ankle Flexible Mount
— Recent Patents: Michael W. Ryan 10-21(177)
Artificial Foot with Ankle Joint
— Recent Patents: Werner Haupt 10-27(208)
Artificial Hands
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
— New Terminal Device (Illustrated)
— Contractor Reports: Johns Hopkins 10-27(143-144)
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Background and Information 10-30(8-9)
— Recent Patents: Eino Pihlaja 10-28(257)
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand. Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case and Charles M. Scott 10-26(170-191)
— *See also* Northwestern University
Artificial Hands
— *See also* Upper-Limb Prostheses, Upper-Limb Prosthetics

Artificial Hand and Forearm
— Recent Patents: Gary Eroyan 10-30(287)
Artificial Intraocular Lens
— Recent Patents: Emil W. Deeg and David A. La Marre 10-30(287)
Artificial Larynx
— Development and Evaluation of a New Artificial Larynx. Contractor Reports: L.P. Goldstein, H. Rothman, and C. Oliver (VA Hospital, Gainesville, Florida) 10-29(186) 10-30(278-279)
— Phase I-Design 10-30(278)
— Phase II-Measurement and Analysis 10-30(279)
Artificial Leg
— Recent Patents: Willem Zevering 10-26(375)
Artificial Leg with Stable Link-Type Knee Joint
— Recent Patents: Denis Ronald William May 10-23(358)
Artificial Limb Research Program
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
Artificial Limbs
— Developing a Permanently Attached Artificial Limb: C. William Hall 10-22(144-157)
— The Development of Artificial Limbs for Lower Limbs: Hans A. Mauch 10-22(158-166)
— Electrocutaneous Feedback for Artificial Limbs — Summary Progress Report, February 1, 1974, through July 31, 1975: Ronald E. Prior and John Lyman 10-24(3-37)
— Permanently Attached Artificial Limbs. Contractor Reports: C. William Hall (Southwest Research Institute, San Antonio, Texas) 10-21(145, no report) 10-22(144–157) 10-23(321–327) 10-24(243-249) 10-25(211-212) 10-26(331, no report) 10-27(165) and William Mallow 10-28(188–191) 10-29(155–158) 10-30(245–248) For progress during the 10-25 and 10-26 report periods, *see* the article Skeletal Extension Development: Criteria for Future Designs 10-26(69–96)
— Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior and Charles M. Scott 10-24(43–50)
— Research and Development in the Field of Artificial Limbs. Contractor Reports: Hans A. Mauch (Mauch Laboratories) 10-21(118-121) 10-23(279-281) 10-24(214-217) 10-25(179-182) 10-26(273-275) 10-27(121-126) 10-28(132-134) 10-29(117-120) 10-30(193, no report)
— Cosmetic Foot-Shank Transition 10-23(280) 10-24(217) 10-25(179)
— Foot Attachment 10-24(217) 10-25 (179) 10-26(273-274)

— Hydraulic Ankle Control System 10-27 (121-122) 10-28(132-133) 10-29(117-118)
— Hydraulic Knee Control System for Geriatric Amputees 10-27(122-123) 10-28(134)
— Hydraulic System 10-21(118-121) 10-23(279-281) 10-24(214-216) 10-25(179-182) 10-26(273-275) 10-27(121-126) 10-28(132-134)
— New Three-Part Knee Bolt Design 10-26(274-275) 10-27(123-126) 10-29(120)
— Shank Attachment 10-24(216) 10-25(179) 10-26(274)
— S-N-S System 10-21(118-119) 10-23 (279-280) 10-24(214-215) 10-27(122) 10-29(119-120)
Artificial Limb With Three-Part Cosmetic Covering
— Recent Patents Herbert Thompson 10-28(257)
Artificial Muscle
— Recent Patents: Jerry D. Helmer and Kenneth E. Hughes 10-24(284)
Artificial Wrist and Arm Prosthesis
— Recent Patents: Edward Horvath 10-28(257)
Asbelle, Charles C.
— Functional Ankle for a Prosthetic Limb. Recent Patents 10-29(195)
— Method of Making a Permanent Prosthetic Socket. Recent Patents 10-24(285)
Asian Conference on Work for the Blind
— 5th Conference. Calendar of Events 10-28(265) 10-29(201)
ASME Honors Eugene F. Murphy with Election to Grade of Fellow
— Notes and News 10-27(203-204)
ASME *see* American Society of Mechanical Engineers
Association for the Advancement of Medical Instrumentation
— Calendar of Events 10-24(292)
ASTM Forms Committee on Orthotics and External Prosthetics
— Notes and News 10-22(522)
ASTM *see* American Society for Testing and Materials
Atlas of Orthotics
— New Atlas of Orthotics Reflects Surge of Bioengineering Influences on Terminology, Prescription Methods, and Materials. Notes and News 10-25(243-245)
Atmospheric Pressure Suspension (APS)
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Socket and Harnessing 10-30(21-23)
— Prosthetics Research. Contractor Reports: Robert G. Thompson

and Dudley S. Childress (Northwestern University, Chicago, Illinois)
— Atmospheric Pressure Suspension Sockets 10-27(129) 10-30(177-178)
Audible Outputs of Reading Machines for the Blind, Research on
— Contractor Reports: F.S. Cooper, J.H. Gaitenby, I.G. Mattingly, P.W. Nye, G.N. Sholes. Haskins Laboratories, Inc New Haven, Connecticut 10-21(153-158) A.M. Liberman 10-23(331-335) 10-24(256-261) 10-25(216-218) F. Ingemann, L. Shockey 10-26 (345-348) 10-27(185-187) A. Levitt 10-28(225-228) 10-29(173-178) 10-30(273-275)
Audible Output Print Reading Aids
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
Audiology and Speech Pathology Centers
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— New Two-Year Test Rotation Program 10-25(122-127)
Audiology *see* Hearing Aids
Auditory Impairment Simulation Development (Contractor Reports: Eastern Blind Rehabilitation Center) 10-30(261-262)
Auditory Research Laboratory VA Hospital, Washington, D.C.
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Test and Research Program 10-25(121-122)
— New Two-Year Test Rotation Program 10-25(122-127)
Auditory Selection Test Revised and Shortened
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Other Activities 10-26(156-157)
Auditory Sensory Feedback *see* Sensory Feedback *see also* Limb Load Monitor
Augmented Sensory Feedback *see* Sensory Feedback
Ausmus Manufacturing Co., Independence, Missouri
— Ausmus Moto-Stand 10-28(114)
Autolift
— VAPC Research Report 10-26(253-255) 10-30(137-139)
Automatic Pacer for Reading Machine Probe
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Conclusions 10-26(158-161)

— Mauch Laboratories "Pacer" and "Colineator" Devices (Illustrated) 10-24(263)
Automatic Transmission (Bicycle Type) for Powered Wheelchairs
— VAPC Research Report 10-26(236-239)
Auto-Monitoring Communication Devices for Handicapped Persons
— Recent Patents: Greg C. Vanderheiden, David F. Lamers, Chris Daniel Geisler, and Andrew M. Volk 10-24(284)
Automotive Adaptive Aids, Equipment *see* Automotive Driving Aids
Automotive Aids for the Handicapped: Anton Reichenberger 10-22(53-54)
Automotive Driving Aids
— Automotive and Driving Aids, VAPC Research Report
— Proposal of Preliminary Plan for Evaluation of Adaptive Equipment for Handicapped Drivers in Accordance with Public Law 91-666. 10-23(251-253)
— Servo-Type Driving Controls for the Handicapped (Double-Wheel Concept) 10-23(253-255) 10-24(196-198)
— Tie-Down for Wheelchair-Riding Van Passengers 10-23(257)
— Driving Seats for Vans 10-23(257-258)
— Compliance Testing, VAPC Research Report
— Adaptive Automotive Hand Controls, Methods Discussed 10-23(260-262)
— February 26, 1976, Listing of Manufacturers whose Products Have Been Approved for Issuance 10-24(201-202)
— VAPC Offer of Technical Help to Manufacturers of Adaptive Devices in Complying with Current VA Standards 10-24(198)
— Development and Evaluation of Advanced Automotive Adaptive Equipment. Contractor Reports: Make McDermott, Jr., and Lewis A. Leavitt (Texas A&M University College of Engineering, College Station, Texas 10-25(205-206) 10-26(317-320) 10-27(149-154)
— Integrated Mobility System Test and Evaluation 10-25(206)
— Driver Evaluation Device 10-27(154)
— Secondary Controls Panel 10-27(154)
— Wheelchair Restraint 10-27(154)
— Servo-Control System Test and Evaluation 10-25(206) 10-26(318)
— Testing and Evaluation of Driver Control Systems 10-27(151-152)
— Wheelchair Lift Evaluation 10-25(205-206) 10-26(318-319) 10-27(149-151)
— Wheelchair Restraint Evaluation 10-26(319-320) 10-27(153)
— Design Standards and Test Criteria for Automotive Driving Aids, origin described, VAPC Research Report 10-23(251-253)

— Development of Standards for Van Wheelchair Lifts, VAPC Research Report 10-25(169)
— Driver Safety in Modified Vans: Charles M. Scott, Mobility Engineering and Development, Inc. 10-22(377-387)
— Control Systems 10-22(377-378)
— Driver Seating 10-22(379)
— Driver's Seat Requirements 10-22(379-387)
— E-Z Tilt-a-Board Loader for Wheelchairs (Illust.) VAPC Research Report 10-28(122-123)
— EZ-1 Wheelchair Carrier for Passenger Car Trunk (Illust.) VAPC Research Report 10-28(123-125)
— The Improvement of Assistive Systems Through Research, Design, Clinical Testing and Team Evaluation. Contractor Reports: P.H. Newell, Jr., and L. A. Leavitt (Texas A&M University) 10-21(138-139) 10-23(312)
— Mann's E-Z Way Chair Lift for Wheelchairs, VAPC Research Report 10-28(124)
— Pak-A-Rak Rear Bumper Mounted Wheelchair Carrier (Illust.) VAPC Research Report 10-30(144-145)
— Passenger Safety in Vehicles for the Handicapped. Contractor Reports: C.M. Scott (Mobility Engineering and Development, Playa Del Rey, California) 10-21(145-146)
— Driver's Seat Holding Device 10-21(146)
— Passenger-Chair Holding Device 10-21(146)
— Vehicle Driver's Seat Module 10-21(145)
— Power Car Door. VAPC Research Report 10-26(257) 10-27(116)
— Safety During Mobility: Make McDermott, Jr., Paul H. Newell, Jr., and Lewis A. Leavitt 10-22(388-390)
— Servo-Type Driving Controls for the Handicapped. VAPC Research Report 10-23(253-254)
— Special Vans Driven by Paralyzed Vets from N.Y. to Washington, D.C. Notes and News 10-22(522-524)
— Tri-Pin Quad Steering Device. VAPC Research Report 10-26(259)
— VA Standard Design and Test Criteria for Safety and Quality of Special Automotive Driving Aids (Adaptive Equipment) for Standard Passenger Automobiles (VAPC-A-7505-8) 10-25(162-167)
— VA Standard Design and Test Criteria for Safety and Quality of Automatic Wheelchair Lift Systems for Passenger Motor Vehicles (Federal Register Vol. 43, No. 96, Wednesday, May 17, 1978, pages 21390-21402. 10-30(148-173) VAPC Research Report
— Van Wheelchair Lift Manufacturers and Van Modifiers Recognized by VAPC, VAPC Research Report 10-25(169-170)

nized by VAPC, VAPC Research Report 10-25(169-170)
— Volvo Driving System. VAPC Research Report 10-27(116)
— Volvo Servo-Control System. VAPC Research Report 10-26(258)
Automotive Seating Systems *see* Automotive Driving Aids
Autonomic Functions
— Biofeedback — Background and Applications to Physical Rehabilitation: C. P. Wooldridge and C.A. McLaurin 10-25(25-37)
— Introduction 10-25(25-27)
Auxiliary Ski for Physically Handicapped Persons
— Recent Patents: Takafusi Negi 10-23(358)
Avery, Roger
— A Sensory Feedback System for an Upper-Limb Amputation Prosthesis: F.W. Clippinger, R. Avery, and B.R. Titus 10-22(247-258)
Avery TNS
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)

B

Babb, Margaret I.
— Clinical Application of Electrode Implantation in the Human Body. Contractor Reports: Michael H. Chase, and Margaret I. Babb (Brain Information Service, The Center for Health Sciences, University of California at Los Angeles, Los Angeles, Calif.) 10-21(147-148)
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
Back Braces
— Evaluation and Further Development of New Designs for Back Braces: Charles W. Radcliffe 10-22(185-187)
— Studies of Spinal Supports 10-22(185-187)
— Evaluation and Further Development of New Design for Back Braces. Contractor Reports: Charles W. Radcliffe, Don M. Cunningham, and James M. Morris (University of California, Berkeley) 10-21(126) 10-24(222) 10-25(198)
— Semiflexible Body Jackets 10-23(289)
Bailey III Cushion Grip Tape
— VAPC Research Report 10-28(125-126)
Bajema, S. L.
— Isotorque Ankle Dorsiflexor Corrective Splint, VAPC Research Report 10-21(106-107)

Barnett, M. Robert
— Winner of 1976 Migel Medal. Notes and News 10-26(371)
— Retiring from AFB. Notes and News 10-21(174)
Barredo, Joseph G.
— Below-The-Knee Prosthesis. Recent Patents 10-25(258)
Barrier-Free Environment
— Bibliography Published on Architectural Barrier-Free Designs for the Handicapped. Notes and News 10-22(524)
— A Resolution for a Barrier-Free Environment. Notes and News 10-24(276)
A Basic Theme of Cooperation: Eugene F. Murphy 10-22(1-4)
Bathing Aids to the Handicapped, Greeley, Colorado
— Portable Inflatable Bathtub (Illust.) 10-30(146-147)
Battelle Memorial Institute
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Optophone Developed by Battelle in 1957-1958. 10-26(139-140)
Batteries
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The C-5 Laser Cane 10-30(91-95)
— The Binaural Sensory Aids (BSA) 10-30(98-102)
— Guidelines for Design of Battery-Powered Devices 10-30(78-80)
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
— Battery Packs 10-24(123-124)
— Chargers 10-24(124)
Battery Monitor for Powered Wheelchair
— VAPC Research Report 10-21(86-88)
Battery Monitors for Wheelchairs
— VAPC Research Report 10-23(228)
Beck, Lucille
— The Development of Improved Techniques for the Analysis of Hearing-Aid Performance. Contractor Reports: G.D. Causey, E. Elkins, and L. Beck (BioCommunications Laboratory, University of Maryland, College Park, Md.) 10-23(342-346) 10-24(269 no report) 10-25 (231-233) 10-26(357-360) J.L. Punch, and H.C. Schweitzer (VA Hospital, Washington, D.C.) 10-27(191-196) 10-28(235-238) 10-29(179-185) 10-30(276-278)
— Influence of Input and Gain Values Upon Electroacoustic Properties of Hearing Aids. Contractor Reports: G.D. Causey,

E. Elkins, and L.B. Beck (BioCommunications Laboratory, University of Maryland, College Park, Maryland) 10-21(166-170)

Becker, Robert O.
— Evaluation of Electrical Techniques for Stimulation of Hard Tissue Growth. Contractor Reports: R.O. Becker, J.A. Spadaro, and A.A. Marino (VA Hospital, Syracuse, New York) 10-27(180-184) 10-28(224 no report) 10-29(133-136) 10-30(206-209)

Beds
— Blair Bed 10-28(115-116)
— Mobile Bed/Wheelchair Development: Jacquelin Perry and James Allen 10-22(370-376)
— Royalaire Bed 10-26(253-254)
— Sevier Mobile Bed 10-26(248-250)

Bed-Chair
— Contractor Reports: Jacquelin Perry. The Professional Staff Association of the Rancho Los Amigos Hospital, Downey, California 10-21(150)
— *see also* Mobile Bed/Chair for High Level Quadriplegics

Bedsores (Pressure Sores)
— Thermographical Investigation of Decubitus Ulcers: Richard S. Trandel, David W. Lewis, and Phyllis J. Verhonick 10-24(137-155)
— Introduction 10-24(137-140)
— *See also* Decubitus Ulcers, Pressure Sore Prevention

Beex, Alosius A.M.
— A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals Using Microprocessors: Daniel Graupe, Alosius A.M. Beex, William J. Monlux, and Ian Magnussen 10-27(4-16)

B. E. Industries, Garland, Texas
— Automatic Torque Converter Bicycle Transmission Adapted for Powered Wheelchairs 10-26(238-239)

Bel, Jean Pierre Louis
— Orthopaedic Appliances. Recent Patents 10-27(209)

Bell, Nancy
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Mobility specialist, member of the Canterbury Team evaluating binaural sensory aids 10-30(98-102)

Below-Elbow Protheses
— Prosthetics Research. Contractor Reports: R.G. Thompson and D.S. Childress (Northwestern University, Chicago, Illinois)
— Below-Elbow Myoelectric Fitting Techniques 10-28(136) 10-29(101-102)
— Synergetic Hook and Hand 10-23(282-283) 10-24(218-219)

10-25(183-184) 10-27(127) 10-29(100) 10-30(176)
Below-Elbow Prostheses
— *See also* Hands, Upper-Limb Prostheses, Upper-Limb Prosthetics, Wrist Disarticulation Prostheses
Below-Knee Amputation With Immediate Postoperative Fitting of Prosthesis
— Contractor Reports: Wesley S. Moore, A.D. Hall, and L.A. Wilson. VA Hospital, San Francisco, California 10-21(128) 10-23(300) 10-24(225 no report) 10-25(200 no report) 10-26(307) 10-27(142 no report) 10-28(156 no report) VA Hospital Tucson, Arizona 10-29(124-125) 10-30(199)
Below-Knee Amputation for Vascular Insufficiency With Immediate Postoperative Fitting of Prosthesis *title changed to* Below-Knee Amputation With Immediate Postoperative Fitting of Prosthesis
Below-Knee Prostheses
— Below-Knee Prostheses: Douglas A. Hobson 10-22(492-493)
— Components 10-22(492)
— Cosmesis 10-22(492-493)
— Socket Design 10-22(492)
— Suspension 10-22(492)
— Graphite-Epoxy Knee Joint for Below-Knee Prosthesis 10-26(216)
— Prosthetics Research. Contractor Reports: R.G. Thompson, and D.S. Childress (Northwestern University)
— Intermediate Below-Knee Prostheses 10-30(177-178)
— Lightweight Below-Knee Prosthesis 10-27(128) 10-28(137-138) 10-29(102) 10-30(177)
— Temporary Thermoplastic B/K Prostheses 10-29(102-103)
— Study of Interface Pressures in the Below-Knee Prosthesis (Physiological Suspension) — an Interim Report: Ernest M. Burgess and A. James Moore 10-28(58-70)
— Ultralight Below-Knee Prosthesis. Contractor Reports: A.B. Wilson, Jr. (Moss Rehabilitation Hospital, Philadelphia, Pennsylvania) 10-27(176-179) 10-28(218-219) 10-29(122-123) C.M. Pritham 10-30(196-197)
Below-The-Knee Prosthesis
— Recent Patents: Joseph G. Barredo 10-25(258)
Benham, Thomas A.
— Fabrication of Obstacle Detectors for the Blind. Contractor Reports: T.A. Benham, J.M. Benjamin, Jr., and D.R. Bolgiano (Bionic Instruments, Inc., Bala Cynwyd, Pa.) 10-21(151-153)
Benjamin, J. Malvern, Jr.
— Fabrication of Obstacle Detectors for the Blind. Contractor Reports: T.A. Benham, J.M. Benjamin, Jr., and D.R. Bolgiano (Bionic Instruments, Inc., Bala Cynwyd, Pa.) 10-21(151-153)

— The Laser Cane: J.M. Benjamin Jr. 10-22(443-450)
— Laser Cane Blind Mobility Aid. Contractor Reports: J.M. Benjamin, Jr., N.A. Ali, and J.R. Bolgiano (Bionic Instruments, Inc., Bala Cynwyd, Pa.) 10-23(330-331) 10-24(256 no report) 10-25(215 no report)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Laser Canes and Other Aids Using Optical Principles 10-30(87-108)

Bennett, Leon
— Clinical and Physiological Evaluation of Seat Cushions for the Paralyzed. Contractor Reports: Leon Bennett (VA Prosthetics Center, New York, N.Y.) and Bok Y. Lee (VA Hospital, Castle Point, N.Y.) 10-29(160-161) 10-30(258)
— Note: current title of above contract is "Seat Cushions for the Paralyzed"
— Slipping Cane and Crutch Tips, Part I—Static Performance of Current Devices: Leon Bennett, and Eugene F. Murphy 10-28(71-90)
— Stump Stress Analysis. Contractor Reports: L. Bennett (New York University, New York, N.Y.) 10-21 (121 *See* "Transferring Load to Flesh") 10-23(282 *See* "Transferring Load to Flesh") 10-24(217-218) 10-25(182-183) 10-26(275-285) (VA Research Center for Prosthetics, N.Y.) 10-27(126 no report) 10-28(134 no report) (VA Prosthetics Center, N.Y.) 10-29(163)
— Transferring Load to Flesh—Part VII. Gel Liner Effects: Leon Bennett 10-21(23-53)
— Transferring Load to Flesh: Leon Bennett 10-22(133-143)
— Transferring Load to Flesh—Part VIII. Stasis and Stress: Leon Bennett 10-23(202-210)

Bennett, Richard R.
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, and A. Wood (Western Blind Rehab. Center, VA Hospital, Palo Alto, Calif.) 10-23(339-341) K. Wiley 10-24(267-268) 10-25(223-227) 10-26(354-356) 10-27(82-91—Report incorporated into article under "A Preliminary Followup Study of Electronic Travel Aid Users") H.S. Paul 10-28(232-235) 10-29(171-173) 10-30(272-273)
— Mobility and Reading Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports: L.E. Apple, R. Bennett, W. Ekstrom, and D.C. Cooper (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, Calif.) 10-21(163-165)
— Reading Aid for the Blind. Recent Patents 10-23(359) 10-26(376)

Bennett, Robert L., Jr.
— Won PCEH "Physician of the Year" Award for 1977. Notes and News 10-28(244-245)

Bennett, Robert S.
— Wheelchair-Mounted Control Apparatus. Recent Patents 10-27(210)
Bennington Stump Sock Co.
— Stump Sock Compliance Testing 10-23(260)
Benton, Cecil T.
— Ankle Block. Recent Patents 10-26(375)
Benz Corp., San Jose, Calif.
— Para-Cycle, Gasoline-Fueled Wheelchair Attachment, VAPC Research Report 10-23(232-234)
Berger, Norman
— Named Associate Professor by NYU School of Medicine. Notes and News 10-25(247-248)
Bernknopf, Joel
— An Occipito-Zygomatic Cervical Orthosis Designed for Emergency Use—A Preliminary Report: G. Rubin, M. Dixon, and J. Bernknopf 10-29(50-64)
Bettle, William
— Turning Bed. Recent Patents 10-30(292)
Bianco, Frank
— Apparatus to Assist Fastening of an Artificial Limb. Recent Patents 10-25(259)
Bibliography Published on Architectural Barrier-Free Designs for the Handicapped
— Notes and News 10-22(524)
BICROS Hearing Aids
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Test and Selection Program 10-25(121-122)
— Development of Test Procedures for Evaluation of Binaural Hearing Aids—A Final Report: Raymond T. Carhart and Lamar Young 10-26(9–45)
— Binaural Squelch Effect and Development of CROS and BICROS Aids 10-26(12-13)
— Recommended References 10-26(13)
Biddle Engineering Co., Ltd., Halesowen, West Midlands, England
— A-BEC Electric Wheelchair, VAPC Research Report 10-25(145)
Bifocal Lens Which Positions Within the Anterior Chamber
— Recent Patents: Charles W. Neefe 10-28(257)
Bilateral Upper-Limb Prosthetics
— The I.N.A.I.L. Experience Fitting Upper Limb Dysmelia Patients with Myoelectric Control 10-27(17–42)
— Control Systems which Make Possible Utilization of Both Prostheses Simultaneously 10-27(32-40)
Billock, John N.
— A Search for Better Limbs: Prosthetics Research at Northwestern

University: D.S. Childress, J.N. Billock, and R.G. Thompson 10-22(200-212)
Bill Proposed to Rename Center in Honor of Helen Keller
— Notes and News 10-25(246)
Binaural Hearing Aids
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. A Final Report 10-26(9-45)
Binaural Sensory Aid (BSA)
— Binaural Sensory Aid for the Blind: Howard Freiberger 10-22(75-76)
— Binaural Sensory Aid: Loyal E. Apple (Western Blind Rehabilitation Center) 10-22(459)
The Binaural Sensory Aids (BSA)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Binaural Sensory Aids 10-30(98-102)
Binaural Sensory Aids for the Blind *see also* Sonicguide
Binaural Squelch Effect
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. A Final Report: Raymond T. Carhart and Lamar Young 10-26(9-45)
— Binaural Squelch Effect 10-26(12 – 13)
BioCommunications Laboratory
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Test and Selection Program 10-25 (121-122)
— New Two-Year Test Rotation Program 10-25(122-127)
Bioelectrically Controlled Prosthetic Member
— Recent Patents: Robert B. Jerard and Cord W. Ohlenbusch 10-24(284)
Bioelectrodes
— Recent Patents: Takuya R. Sato 10-29(195)
Biofeedback — Background and Applications to Physical Rehabilitation: C. P. Wooldridge and C.A. McLaurin 10-25(25-37)
— Abstract 10-25(25)
— Clinical Research with Cerebral Palsied Children 10-25(28-34)
— Conclusion 10-25(34-35)
— Introduction 10-25(25-27)
— A Theoretical Framework 10-25(27-28)
— Clinical Evaluation of a Sensory Feedback Device: The Limb Load Monitor: G. Wannstedt and R.L. Craik 10-29(8 – 49)
— Patient Selection Criteria and Therapy Goals (Patients with Lower-Limb Amputation, Patients with Hemiplegia) 10-29(16)
— Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects. Contractor Reports: Paul P. Griffin, Richard Shiavi, Sherry Champion, and Frank Freeman

— Biofeedback (Myofeedback) in Rehabilitation for Hemiplegia 10-30(217 – 223)
Biomaterials
— Current Status — Prosthetic Materials for Maxillofacial Reconstruction: James W. Schweiger and John F. Lontz 10-22(408-409)
— Developing a Permanently Attached Artificial Limb: C. William Hall 10-22(144-157)
— Bone Interfacing 10-22(153-156)
— Musculotendinous Skin Interfacing 10-22(151-153)
— Skin Interfacing 10-22(145-151)
— Electrochemical Behavior of Metals (metal alloy cathodes) which could be used for electrical stimulation of bone growth (Contractor Reports: Robert O. Becker et al.) 10-30(206-208)
— The First International Symposium On Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
— Maxillofacial Restorative Biomaterials and Techniques. Contractor Reports: J.W. Schweiger and J.F. Lontz (Temple University School of Dentistry, Philadelphia, Pa.) 10-21(143-145) 10-23 (319-321) 10-24(323-330) 10-25(241-243) 10-26(210-211) 10-27(161-165) 10-28(182-188) 10-29(145-155) VA Hospital, Wilmington, Delaware 10-30(223-244)
— Adhesives 10-23(321) 10-26(328-329)
— Biomechanical Replication of Living Tissue (Tensile Characteristics) 10-26(324-325)
— Changes in Tactile Quality With Hygienic Cleaning 10-26(327)
— Changes in Tactile Quality With Temperature 10-26(325-326)
— Color Standardization 10-26(327-328)
— Colorants 10-23(320-321)
— Digital Color Difference Indices of Human Skin 10-27(162-163)
— Digital Color Difference Measurements for Artificial Pigments 10-27(163-164)
— Economic and PracticalConsiderations
— Investigation of Elastomers and Polymers for Compatibility With Maxillofacial Reconstructions, Part I. 10-21(143-144) Part II. 10-21(144-145)
— Phase VI — Production 10-30(224-244)
— Safety and Performance of Maxillofacial Prostheses-Conformity With Medical Devices Act (1976) 10-29 (145-153)
— Stability to Actinic Exposure 10-26(325-326)
— Toxicological Testing for Product and Process Certification 10-26(329)
— Work During Next Quarterly Period 10-26(330)
— Orthopedic Implant Device Retrieval and Analysis

— Contractor Reports: A.M. Weinstein. VA Hospital, New Orleans, Louisiana 10-27(179-180) 10-28(219-224) 10-29(138-139) 10-30(215-216)
— Toward a Nationwide Retrieval Program 10-28(223-224)
— Permanently Attached Artificial Limbs
— Contractor Reports: C.W. Hall. (Southwestern Research Institute, San Antonio, Texas 10-21(145, no report) 10-23(321-327) 10-24(243-249) 10-25(211-212, For progress during this report period, *see* "Skeletal Extension Development: Criteria for Future Designs" pp. 69-96) 10-26(331, For progress during this report period, *see* 10-25, pp. 69-96) 10-27(165) also William Mallow 10-28(188-191) 10-29(155-158) 10-30(245-248)
— Bone Interfacing Technique 10-23(323-324)
— Intramedullary Approaches 10-29(155-158)
— The Involuted Approach—A New Method for Percutaneous Skeletal Attachment 10-27(166-167)
— An Involuted Intramedullary Skeletal Extension 10-28(188-191)
— Skin Interfacing Techniques 10-23 (322-323) 10-27(165-168)
— Tendon Interfacing Techniques 10-23(324-326)
— Skeletal Extension Development: Criteria for Future Designs: Charles William Hall, P.A. Cox, and William A. Mallow 10-25(69-96)
— Model Development 10-25(72-79)
— Artificial Tendon 10-25(76-79)
— Intramedullary Rod Extension 10-25(72-74)
— Supracortical Extension 10-25(74-76)
— Tissue Interfacing 10-25(70-72)
— Bone Interfacing 10-25(71)
— Musculotendinous Interfacing 10-25(71)
— Skin Interfacing 10-25(70)
Biomechanical Parameters
— Electrical Stimulation of Limbs: Part III. Joint Position Control: Alain Fournier, Etienne Dombre, and Philippe Coiffet 10-25(5-24)
— Determination of the Biomechanical Parameters 10-25(7-8)
Biomechanical Research and Development Unit (BRADU) Roehampton, London, England
— VAPC Collaborative Test Series (ISPO Program): VAPC Research Report 10-24(199-200)
Biomechanics Symposium in Connection with the ASME 1979 Summer Applied Mechanics/Bioengineering/Fluids Engineering Conference
— Calendar of Events 10-29(202) 10-30(299)

Bionic Instruments, Bala Cynwyd, Pennsylvania
— Fabrication of Obstacle Detectors for the Blind. Contractor Reports: Thomas A. Benham, J. Malvern Benjamin, Jr., and D. Ridgely Bolgiano 10-21(151-153)
— Laser Cane Blind Mobility Aid. Contractor Reports: J. Malvern Benjamin, Jr., Naxir A. Ali, and D. Ridgely Bolgiano 10-23(330-331) 10-24(256) 10-25(215)
— The Laser Cane: J. Malvern Benjamin, Jr. 10-22(443-450)
— Laser Typhlocane: Howard Freiberger 10-22(75)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Laser Canes and Other Aids Using Optical Principles 10-30 (87-108)
— The Laser Cane 10-30(87)
Blair Bed
— VAPC Research Report 10-24(190) 10-28(115-116)
Blair, E. Allen
— Mattress for Preventing Bedsores. Recent Patents 10-25(259)
Blanching
— Thermographical Investigation of Decubitus Ulcers: Richard S. Trandel, David W. Lewis, and Phyllis J. Verhonick 10-24(137-155) *See also* "Edge Light"
— Effects of Pressure on Tissue 10-24(140-142)
Blasch, Bruce B.
— Workshop on Low Vision Mobility: L.E. Apple and B.B. Blasch 10-26(46-138)
Blinded Veterans
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: G.M. Gillispie, W. De L'Aune, P. Gadbaw, C. Lewis, and D. Garner (Eastern Blind Rehabilitation Center, VA Hospital, West Haven, Connecticut)
— Indicators of Blinded Veterans' Capacity to Use Time Compressed Speech 10-22(464)
— Normative Personality Data for Blinded Veterans 10-21(171-172) 10-23(349)
— Orientation and Mobility Performance in the Blind 10-23(349)
— Patient Satisfaction Survey 10-21(171) 10-23(249)
— Psychological Evaluation for Central Nervous System Dysfunction in Blinded Veterans 10-22(467)
— Relationships of Perceived Adjustment and Personality Variables 10-21(172)
— Study of Factors Related to Effective Use of Electronic Reading Machines by Veterans 10-22(467)
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, A. Wood (Western Blind Rehabilitation

Center. VA Hospital, Palo Alto, California)
— Expanded Followup Study of CCTV Use 10-25(225-226)
— Low Vision Aids and Training 10-26(354-355)
— Mobility Aids and Training 10-26(354) 10-28(232-233) 10-29 (171-172)
— Reading Aids and Training 10-26(355-356) 10-28(233-234) 10-29(172) 10-30(272-273)
— A Preliminary Followup Study of Electronic Travel Aid Users: Nancy C. Darling, Gregory L. Goodrich, and J. Kenneth Wiley (Western Blind Rehabilitation Center) 10-27(82 – 91)
— Blinded Veterans Association
— 33rd Annual Convention. Calendar of Events 10-28(264)
Blind Orientation and Mobility
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Canes and Walking Aids 10-30(47-74)
— Folding or Collapsible Canes 10-30(50-54)
— High-Visibility Canes 10-30(55-56)
— The Long Cane 10-30(48-50)
— Support or Orthopedic Canes and Crutches 10-30(56-70)
— Walkers 10-30(70-74)
— Wheeled Canes 10-30(55)
— Conclusions — ETA's 10-30(111-112)
— Electronic Travel Aids (ETA's): History and Development 10-30(75-108)
— Background 10-30(75-77)
— Benefits from ETA's 10-30(78)
— The Binaural Sensory Aids (BSA) 10-30(98-102)
— Candidate Requirements 10-30(80)
— Considerations in Selection 10-30(80-81)
— Definition and Purpose 10-30(77)
— Display of Environmental Information 10-30(81-82)
— Functions Performed by ETA's 10-30(77-78)
— Guidelines for Design 10-30(78-80)
— Laser Canes and Other Aids Using Optical Principles 10-30 (87-96)
— Other Electronic Devices and Systems 10-30(102-108)
— The Sonicguide 10-30(97)
— The Torch 10-30(97-98)
— Types of ETA;s 10-30(82-87)
— Experimental Devices 10-30(108-111)
— Electrocortical Prosthesis 10-30(108-109)
— The Tactile Vision Substitution System 10-30(109-111)
— Introduction 10-30(47)
— References 10-30(112-117)
— A Preliminary Followup Study of Electronic Travel Aid Users.

Nancy Darling, Gregory L. Goodrich, and J. Kenneth Wiley 10-27(82 – 91)
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— *See* detailed listing under "Low Vision"
Blind Rehabilitation
— VA Coordinating Committee on Blind Rehabilitation Held First Meeting March 27, 1978. Notes and News 10-30(282)
Blind Rehabilitation Centers Research
— Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois
— Clinical Application Study of Reading and Mobility Aids for the Blind.
— Contractor Reports: J.D. Malamazian, H. Lauer, and J.J. Whitehead 10-23(337-338) 10-24(264-265)
— *See* detailed listing under "Central Rehabilitation Section" entry
— Clinical Study of Mobility Aids for the Blind
— Contractor Reports: John D. Malamazian, Leicester W. Farmer, and James J. Whitehead. 10-26(350-352) 10-27(187-190) 10-28(230-232) 10-29(167-169) 10-30(268-270)
— *See* detailed listing under "Central Rehabilitation Section
— Clinical Trails of Reading Machines for the Blind.
— Contractor Reports: John D. Malamazian and Harvey L. Lauer. 10-21(161-162) 10-23(338-339) 10-24(265-266) 10-25(221-222) 10-26(353-354) 10-27(190-191) 10-28(229-230) 10-29(170-171) 10-30(270-271)
— *See* detailed listing under "Central Rehabilitation Section"
— Reading Aids for the Blind: Harvey L. Lauer 10-22(64-72)
— Eastern Blind Rehabilitation Center, VA Hospital, West Haven, Connecticut
— Clinical Application Study of Reading and Mobility Aids for the Blind
— Contractor Reports: George M. Gillispie, William De l'Aune, Patricia Gadbaw, Chester Lewis 10-21(170-173) 10-23(348-351) 10-24(271-274) 10-25(238-241) also Donald E. Garner 10-26(360-363) 10-27(196-198) 10-28(238-240) 10-29(164-167) 10-30(261-268)
— Research at the Eastern Blind Rehabilitation Center: George M. Gillispie and William De l'Aune 10-22(463-468)
— Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California
— Clinical Application Study of Reading and Mobility Aids for the Blind
— Contractor Reports: Richard R. Bennett, Nancy Darling, A.

Frost, Gregory L. Goodrich, R. Ward, A. Wood. 10-23(339-341) J. Kenneth Wiley 10-24(267-268) 10-25(223-226) 10-26(354-357) 10-27(191, report incorporated into article entitled "A Preliminary Followup Study of Electronic Travel Aid Users" pp. 82-91) also H. Stanton Paul 10-28(232-235) 10-29(171-173) 10-30(272-273)

— Experience with Closed Circuit Television in the Blind Rehabilitation Program of the Veterans Administration: Edwin B. Mehr, Alan B. Frost, and Loyal E. Apple (Western Blind Rehabilitation Center) 10-21(54-68)

— A Preliminary Followup Study of Electronic Travel Aid Users. Nancy Darling, Gregory L. Goodrich, and J. Kenneth Wiley 10-27(82-91)

Blind Rehabilitation Research

— Instruction In, and Evaluation of, Reading Machine Techniques

— Contractor Reports: D.W. Hathaway, M. Butow, and R.D. Rouse. The Hadley School for the Blind, Winnetka, Illinois 10-23(339) 10-24(266-267) 10-25(222-223) 10-26(254, Report incorporated in article entitled "Research and Evaluation of Audible Output Print Reading Aids for the Blind — A Final Report" appears in 10-26(139-169)

— The Reading of Printed Materials by the Blind. Contractor Reports: R.A. Weisgerber (American Institutes for Research, Palo Alto, California) 10-21(167-170) 10-23(346-348) 10-24(269-270) 10-25(233-238)

— Evaluation of an Ink Print Reading Aid: the Stereotoner 10-25(233-236)

— Evaluation Procedures for Environmental Sensing, Orientation and Mobility by the Blind 10-25(233, 236-238)

— Research on Audible Outputs of Reading Machines for the Blind,

— Contractor Reports: F.S. Cooper, J.H. Gaitenby, I.G. Mattingly, P.W. Nye, G.N. Shoes. (Haskins Laboratories, Inc. New Haven, Connecticut) 10-21(153-158) A.M. Liberman 10-23(331-335) 10-24(256-261) 10-25(216-218) F. Ingemann, L. Shockey 10-26(345-348) 10-27(185-187) A. Levitt 10-28(225-228) 10-29(173-178) 10-30(273-275)

— Comparisons of Synthetic Speech Intelligibility 10-23(333-334)

— Conclusions 10-24(261) 10-25(218) 10-26(347-348)

— Development of New Synthesis Methods 10-24(257-258)

— Development of Rules with the FOVE Program 10-27(185) 10-28(225-226)

— Direct Synthesis 10-29(174) 10-30(274)

— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret

Butow (The Hadley School for the Blind) 10-26(139-169)
— Research and Development in the Field of Reading Machines for the Blind
— Contractor Reports: H.A. Mauch and Glendon C. Smith. Mauch Laboratories, Dayton, Ohio 10-23(336-337) 10-24 (261-264) 10-25(218-219) 10-26(348-350) 10-27(187, report incorporated in article under the same title, pp. 61-71) 10-28 (228-229)
— Research and Development in the Field of Reading Machines for the Blind: Glendon C. Smith, and Hans A. Mauch 10-27(61-71)
— Prototype Evaluation 10-27(70)
— Progress in Cognodictor Development 10-27(62-69)
— Cognidictor Software Development 10-27(68-69)
Blind Rehabilitation Research *see* also Reading Machines
Blood Flow
— Edge Light: a New Approach to Studying the Microvascularization of the Skin. Jeanette F. Kissinger, Phyllis J. Verhonick, and David W. Lewis 10-29(65-78)
— Hemodynamic Evaluation of Postoperative and Preoperative Amputees. Contractor Reports: Bok Y. Lee, Frieda S. Trainor, John L. Madden, Emilio Ejercito 10-21(142-143) 10-23(318-319) 10-24(239-240). David Kavner 10-25(209-210) 10-26(322-323) 10-27(158-161) 10-28(180-181) 10-29(125-127) 10-30(199-200)
— Hemodynamic Evaluation in Selection of Amputation Level: Bok Y. Lee 10-22(85-104)
— The Importance of Amputation Level Determination: Wesley S. Moore. (Guest Editorial) 10-28(1-3)
— Skin Blood Flow and Healing: Wesley S. Moore 10-22(105-108)
— *See also* Edema, Ischemia
Blue Grass Industries, Inc., Carlisle, Kentucky
— Speedo Aqualift Swimsuit 10-25(154-156)
Body Powered Prostheses
— Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior and Charles M. Scott 10-24(43-50)
— Background 10-24(43-46)
— A Five-Year Review of Clinical Experience with Johns Hopkins University Externally Powered Upper-Limb Prostheses and Orthoses: Gerhard Schmeisser, Jr., and Woodrow Seamone 10-23(211-217)
— Selection and Evaluation Process: Comparison with Externally Powered Prostheses 10-23(214)
— The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients with Myoelectric Control. Hannes Schmidl 10-27(17 – 42)
— Mechanism for simultaneous or individual control of elbow

joints in cases of bilateral congenital malformations (Illustrated) 10-27(24 – 29)
Body Motion Sensor
— A Five-Year Review of Clinical Experience with Johns Hopkins University Externally Powered Upper-Limb Prostheses and Orthoses: Gerhard Schmeisser, Jr., and Woodrow Seamone 10-23(211-217)
— Introduction 10-23(211-214)
Body Support Means
— Recent Patents: Reginald Dyson 10-27(208)
Body Support Systems
— Parapodium for Adult Paraplegics: Martin T. Prast 10-22(391-403)
— Seating Systems for Body Support and Prevention of Tissue Trauma. Contractor Reports: I. Perkash (VA Hospital, Palo Alto, California) 10-29(162-163) W. Motloch (Stanford University, Children's Hospital, Palo Alto, California) 10-30(258-260)
Body Support Systems
— *See also* VAPC Research Reports-Spinal Cord Injury Rehabilitation-Body Support Systems
— *See also* Standers
— *See also* Pressure Sore (Decubitus Ulcer) Prevention and Treatment Systems
Bolgiano, D. Ridgely
— Fabrication of Obstacle Detectors for the Blind. Contractor Reports: T.A. Benham, J.M. Benjamin, Jr., and D.R. Bolgiano (Bionic Instruments, Inc., Bala Cynwyd, Pa.) 10-21(151-153)
— Laser Cane Mobility Aid. Contractor Reports: J.M. Benjamin, Jr., N.A. Ali, and D.R. Bolgiano (Bionic Instruments, Inc., Bala Cynwyd, Pa.) 10-23(330-331) 10-24(256 no report) 10-25(215 no report)
Bone
— Skeletal Extension Development: Criteria for Future Designs: Charles William Hall, P.A. Cox, and William A. Mallow 10-25(69-96)
— Stresses in the Bone and Supracortical Extension 10-25(81-86)
Bone Conduction Eyeglass Hearing Aids
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Test and Selection Program 10-25(121-122)
Bone Healing
— Acceleration of Bone Healing by Electrical Stimulation. Contractor Reports: George Van B. Cochran (St. Luke's Hospital, New York, N.Y.) 10-21(141-142) 10-23(315-318) 10-24(238-239)

(Helen Hayes Hospital, West Haverstraw N.Y.) 10-25(208-209) 10-26(322 no report) 10-27(157-158) 10-28(179-180) 10-29(136) 10-30(209)
— Acceleration of Bone Healing by Electrical Stimulation: George Van B. Cochran 10-22(291-294)
— Evaluation of Electrical Techniques for Stimulation of Hard Tissue Growth. Contractor Reports: Robert O. Becker, J.A. Spadaro, and A.A. Marino (VA Hospital, Syracuse, New York) 10-27(180-184) 10-28(224 no report) 10-29(133-136) 10-30(206-209)
— Background 10-27(180-184)
— Electrical Osteogenesis — Basic Studies 10-30(206-208)
— Electrical Osteogenesis — Clinical Studies 10-30(208)
— Electrical Stimulation of Bone Growth 10-29(136)
— Electrically Injected Silver Ions as a Local Bactericidal Agent 10-29(133)
— Fracture Healing 10-30(209)
— Present Investigations 10-27(184)
— Regeneration 10-27(180-184) 10-30(208-209)
— Silver Compounds as Additives to Bone Cement 10-29(134)
— Electrochemical Behavior of Various Metals which Could Be Used for Electrical Stimulation of Bone Growth 10-30(206–209)
Bone Interfacing
— Bone Interfacing: C. William Hall 10-22(153-156)
— *See also* Biomaterials
Bone Regeneration *see* Bone Healing (Becker et al.)
Bonfield, Robert B.
— Wheelchairs. Recent Patents 10-29(196)
Bonnel, Francois
— Electrical Stimulation of Limbs: Part I—Basic Studies, Part II—Open Loop Control of Muscular Contraction: P. Rabischong, F. Bonnel, E. Dombre, E. Peruchon, P. Coiffet, B. Fournier, and J. Brebic 10-22(261-290)
Book Review: Gustav Rubin reviews "Spinal Cord Injuries, Comprehensive Management and Research," Prof. Sir Ludwig Guttman, 1973 10-22(530-531)
Books *see* Publications of Interest
BPR Sensory-Aids Excerpts on Tape Cassettes Discontinued
— Notes and News 10-24(281)
Braille
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Introduction 10-26(49-50)

Braille Book on American Economic System Prepared by Library of Congress
— Notes and News 10-27(203)
Braille-Reading And Home-Repair Are "Most Wanted" Correspondence Courses for the Blind
— Notes and News 10-25(248-249)
Braille-Using Devices
— Brailling Device Gives Blind Worker Access To Computer And Communications Systems
— Notes and News 10-25(250-251)
— ELINFA Digicassette (tape unit) with Braille Keyboard and 12-Character Reading Display, to be Evaluated 10-30(265)
Brain
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Recording Electrodes 10-23(106-143)
— Stimulating Electrodes 10-23(62-74)
Braun Corp., Winamac, Indiana
— Tri-Wheeler Battery-Powered Cart 10-25(151)
Breakey, James W.
— Knee Prosthesis. Recent Patents 10-25(257)
Breath-Controlled Microfilm Reader
— VAPC Research Report 10-21(92)
Brebic, Jean-Marie
— Electrical Stimulation of Limbs: Part I —Basic Studies, Part II— Open Loop Control of Muscular Contraction: P. Rabischong, F. Bonnel, E. Dombre, E. Peruchon, P. Coiffet, B. Fournier, and J. Brebic 10-22(261-290)
Brighton, Carl T.
— Constant Current Power Pack for Bone Healing and Method of Use. Recent Patents 10-23(358)
British Council for the Rehabilitation of the Disabled
— 6th International Seminar and Exhibition Calendar of Events 10-24(293)
Brown, Dennis N.
— Orthocasting System. Recent Patents 10-27(209)
Brown, Richard H.
— In Vivo Loading of Knee Joint Replacement. Contractor Reports: A.H. Burstein, and R. Brown (Biomechanics Laboratory, Bingham Engineering Bldg., Case Western Reserve University, Cleveland, Ohio) 10-26(339-340) K.G. Heiple, and V.M. Goldberg 10-27(168 *no report*) 10-28(193-194) 10-29(137) 10-30(209-215)
Browning Manufacturing Co., Morgan, Utah
— Graphite-Epoxy SACH Foot Keels 10-26(216-217) 10-28(93)

Bulletin of Prosthetics Research
— Publication Program and Mission Discussed
— Technology Transfer . . . an editorial: Eugene F. Murphy 10-29(1-7)
— Rehabilitative Engineering—A New Era . . . an editorial: Vernon L. Nickel 10-30(1-7)
Bunting Stereo Systems, Bridgeport, Conn.
— Comfortcom Environmental Control System, VAPC Research Report 10-23(241-242)
— Bunting Remote Operated Television, VAPC Research Report 10-24(173-176)
Burch, John L.
— Actuator Device for Artificial Leg. Recent Patents 10-27(208)
Burgess, Ernest M.
— Controlled Environment Treatment for Limb Surgery and Trauma (a Preliminary Report): E.M. Burgess and L.R. Pedegana 10-28(16-57)
— Immediate Postoperative Prostheses Research Study. Contractor Reports: E.M. Burgess (Prosthetics Research Study, Seattle, Wash.) 10-21(126-128) 10-23(290-299) 10-24(222-225) 10-25(198-200) 10-26(301-307) 10-27(137-142) 10-28(152-156) 10-29(123-124) 10-30(197-198)
— A Proposed Technique for the Postoperative Monitoring of Skin Tension in Below-Knee Amputees: E.M. Burgess, C.A. Spolek, and A.J. Moore, Jr. 10-28(4-15)
— A Study of Interface Pressures in the Below-Knee Prosthesis (Physiological Suspension)—an Interim Report: E.M. Burgess, and A.J. Moore 10-28(58-70)
— Surgery as Related to Prosthetics and Orthotics: E.M. Burgess 10-22(15-21)
— A Survey of Lower-Limb Amputees: Prostheses, Phantom Sensations, and Psychosocial Aspects: B. Kegel, M.L. Carpenter, and E.M. Burgess 10-27(43-60)
— Wound Healing: E.M. Burgess 10-22(109-113)
Burris Spinal Cord Injury Recliner
— VAPC Research Report 10-23(238–239)
Burstein, Albert H.
— Engineering Applications in Orthotic and Prosthetic Treatment of Musculoskeletal Defects. Contractor Reports: E. Byron Marsolais, Albert H. Burstein, and Eduard Schulz (VA Hospital, Wade Park, Cleveland, Ohio) 10-26(341-344)
— In Vivo Loading of Knee Joint Replacement. Contractor Reports: A.H. Burstein, and V.H. Frankel (Case Western Reserve Univ.,

Cleveland, Ohio) 10-24(253-254) 10-25(214) Richard H. Brown 10-26(339-340) Kingsbury G. Heiple, Victor M. Goldberg 10-27(168 no report)
— Fluted Hip Nail Implant System for Orthopaedic Surgery. Recent Patents 10-28(257)
— In Vivo Loading on Knee Joint Replacement: A.H. Burstein, V.H. Frankel, and E.B. Marsolais 10-22(193-199)
— Prosthesis-to-Bone Interface System. Recent Patents 10-30(290)
Butow, Margaret
— Development of Correspondence Courses for Personal Reading Aids for the Blind. Contractor Reports: D.W. Hathaway and M. Butow (The Hadley School for the Blind, Winnetka, Ill.) 10-21(162-163)
— Instruction In, and Evaluation Of, Reading Machine Techniques. Contractor Reports: D. W. Hathaway, M. Butow, and R.D. Rouse (The Hadley School for the Blind, Winnetka, Ill.) 10-23(339) 10-24(266-267) 10-25(222-223) M. Carbery 10-26(354 Report incorporated in article under title "Research and Evaluation of Audible Output Print Reading Aids for the Blind.")
— Research and Evaluation of Audible Output Print Reading Aids for the Blind — A Final Report: Michael Carbery and M. Butow 10-26(139-169)
— Teaching the Stereotoner: Its Problems and Rewards: M. Butow 10-22(433-435)
BykFil Rubber Tire Compound
— VAPC Research Report 10-25(150-151)

C

Calendar of Events 10-21(186) 10-22(537-538) 10-23(365-366) 10-24(292-294) 10-25(265-267) 10-26(384-387) 10-27(216-218) 10-28(264-266) 10-29(201-203) 10-30(299-301)
— *see also* Name of Individual Organization
Canadian Conference on Medical Devices in Health Protection
— 1st Conference. Calendar of Events 10-23(365)
Canadian Crutches *see* Forearm Crutches
Canadians Honor Marjorie McGuffin Wood with First Arthur Napier Magill Annual Award
— Notes and News 10-26(372)
Canadian Speech and Hearing Association
— National Convention. Calendar of Events 10-24(292)
Canes

— Glowing Canes for the Blind Traveler. Notes and News 10-28(246 – 247)
— Mobility Devices: Leicester W. Farmer 10-30(47 – 118)
— Canes and Walking Aids 10-30(47-74)
— Support or Othopedic Canes and Crutches 10-30(56 – 70)
— Cane Glider 10-30(56-70)
— Cane Seat 10-30(60)
— Laser Canes and Other Aids Using Optical Principles 10-30(87–102)
— Pyramid Folding Quad Cane, VAPC Research Report (Illust.) 10-28(105-106)
— C-3, C-4, C-5 Laser Canes *see* Laser Cane
Cane Tips
— Slipping Cane and Crutch Tips Part I — Static Performance of Current Devices: Leon Bennett and Eugene F. Murphy 10-28(71-90)
— Conclusions 10-28(90)
— Discussion 10-28(86-90)
— Effects of Age 10-28(89-90)
— Effects of Size 10-28(89)
— Some Assets 10-28(87)
— Some Cautions 10-28(86-87)
— Special Devices 10-28(88-89)
— Special Hazards 10-28(87-88)
— Thrust Load 10-28(89)
— Experimental Methods and Procedure 10-28(73-83)
— Ice 10-28(84-86)
— Results 10-28(84-86)
— Soapy Wet Tile 10-28(86)
A Canterbury Child's Aid
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Other Electronic Devices and Systems 10-30(102-108)
The Canterbury Team
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Binaural Sensory Aids 10-30(98-102)
— Training 10-30(101)
Carbery, Michael
— Instruction In, and Evaluation of, Reading Machine Techniques. Contractor Reports: M. Carbery, M. Butow, and R.D. Rouse (The Hadley School for the Blind, Winnetka, Illinois) 10-26(354-Report for this period is incorporated in an article under title "Research and Evaluation of Audible Output Print Reading Aids for the Blind." 10-26(139-169)
— Research and Evaluation of Audible Output Print Reading Aids

for the Blind — A Final Report: M. Carbery and M. Butow 10-26(139-169)
Carey, Hugh, Governor of New York State
— Honored for Service to the Deaf. Notes and News 10-25(249-250)
Carhart, Raymond T.
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. Contractor Reports: R. Carhart, and W.O. Olsen (Northwestern University, Evanston, Ill.) 10-21(165-166) Lamar Young 10-23(341-342) 10-24(268-269)
— Development of Test Procedures for Evaluation of Binaural Hearing Aids — A Final Report: R.T. Carhart and L.L. Young 10-26(9-45)
— Research on Hearing Aid Design: R.T. Carhart 10-22(420–423)
Carhart, Raymond T. 1912-1975
— Notes and News 10-24(281-283)
Carlson, Lawrence E.
— The Lift Lock: A Device to Increase the Lifting Ability of Dual-Control Prostheses: L.E. Carlson and D.S. Childress 10-23(158-168)
— Position Control of Above-Elbow Prostheses. Contractor Reports: L.E. Carlson (University of Colorado, Boulder, Colorado) 10-29(108-109) 10-30(184-185)
— Research and Development Project on Advanced Orthotic Devices for Adult Paraplegics. Contractor Reports: M.T. Prast (Prast Research Associates, Inc.) and L.E. Carlson (University of Colorado, Boulder, Colo.) 10-25(215) 10-26(340-341) 10-27(169-172) 10-28(195) 10-29(132 no report)
Carpenter, Margaret L.
— A Survey of Lower-Limb Amputees: Prostheses, Phantom Sensations, and Psychosocial Aspects: Bernice Kegel, Margaret L. Carpenter, and Ernest M. Burgess 10-27(43-60)
Case Histories *see* VAPC Clinic Team Evaluation, VAPC Research Report
Case, Philip A.
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand — Background and Preliminary Designs: R.E. Prior, J. Lyman, P.A. Case, and C.M. Scott 10-26(170-191)
Case Western Reserve University, Biomedical Laboratory, Cleveland, Ohio
— In Vivo Loading on Knee Joint Replacement: Albert H. Burstein, Victor H. Frankel, and E. Byron Marsolais 10-22(193-199)
— In Vivo Loading of Knee Joint Replacement. Contractor Reports: R.H. Brown, K.G. Heiple, V.M. Goldberg, and A.H. Burstein 10-24(253-254) 10-25(214) 10-26(339-340) 10-27(168 no report) 10-28(193-194) 10-29(137) 10-30(209-215)

Castiglia, Ignatius F.
— Ankle Wrap. Recent Patents 10-30(287)
— Weight-Redistribution Orthopedic Appliance. Recent Patents 10-30(292)
Castor Portable Standing Frame
— VAPC Research Report 10-27(111) 10-30(133)
Causey, G. Donald
— Development of a Hearing-Aid System with Independently Adjustable Subranges of Its Spectrum Using Microprocessor Hardware. Contractor Reports: D. Graupe (Colorado State University, Fort Collins, Colo.) and G.D. Causey (University of Maryland, College Park, Md.) 10-23(351-352) 10-24(274-275) 10-25(241-242) 10-26(363-364) 10-27(199-200) 10-28(241-242) 10-29(178-179) 10-30(275-276)
— Development of Improved Techniques for the Analysis of Hearing-Aid Performance. Contractor Reports: G.D. Causey, E. Elkins, and L. Beck (University of Maryland, College Park, Md.) 10-23(342-346) 10-24(269 no report) 10-25(231-233) 10-26(357-360) (VA Hospital, Washington, D.C.) also J.L. Punch, and H.C. Schweitzer (VA Hospital, Washington, D.C.) 10-27(191-196) 10-28(235-238) 10-29(179-185) 10-30(276-278)
— Hearing Aids: G.D. Causey 10-22(424-426)
— Hearing Aids and the Veterans Administration: G.D. Causey 10-22(55-63)
— Influence of Input and Gain Values Upon Electroacoustic Properties of Hearing Aids. Contractor Reports: G.D. Causey, E. Elkins, and L.B. Beck (University of Maryland, College Park, Md.) 10-21(166-170)
— Method of and Means for Adaptively Filtering Near-Stationary Noise from Speech. Recent Patents 10-30(289)
— Method of and Means for Scrambling and Descrambling Speech at Audio Frequencies. Recent Patents 10-29(195)
CCTV *see* Closed Circuit Television, Reading Aids for the Blind
Center for Concerned Engineering, Washington, D.C.
— VAPC Contractor to Develop A Combination Wheelchair and Stander 10-24(207)
Central Nervous System (CNS)
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
— A Theoretical Framework 10-25(27-28)
Cerebral Palsied
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
CET *see* Controlled Environment Treatment
Chair-E-Yacht, Inc., Shoshoni, Wyoming

— VAPC Research Report 10-23(231-232)
Chairs
— Crozier Chair *see* Automotive Driving Aids
— Edco-Matic Chair 10-26(251-252)
— IMSECO Orthopedic Seat 10-24(191-192)
— LaCaron Lift Chair Model 76 (Illust.) 10-28(120)
— LEM Power Chair *see* Wheelchairs
— Wayne Chair *see* Wheelchairs
Chair/Van Systems
— Advanced Automotive Adaptive Equipment, Development and Evaluation
— Contractor Reports: M. McDermott, Jr. and L.A. Leavitt. Texas A&M University College of Engineering, College Station, Texas 10-25(205-206) 10-26(317-320) 10-27(149-154)
— Servo-Control System Test and Evaluation 10-25(206) 10-26(318)
— Testing and Evaluation of Driver Control Systems 10-27(151-152)
— Wheelchair Lift Evaluation 10-25(205-206) 10-26(318-319) 10-27(149-151)
— Wheelchair Restraint Evaluation 10-26(319-320) 10-27(153)
— Mobility Aids for the Severely Handicapped
— Contractor Reports: C.M. Scott. Mobility Engineering and Development (MED), Playa Del Rey, California 10-23(327-328) 10-24(249-250) R.E. Prior 10-25(212) MED, Canoga Park, California 10-26(331, Report incorporated into article under same title, pp. 192-213) 10-27(168 *see* article in 10-26, pp. 192-213)
— Electronic Van Control System 10-24(250)
— Joystick Controlled Chair-Van 10-25(212)
— Seat Design 10-23(327-328)
— Van Compatible Wheelchair 10-24(249-250) 10-25(212)
— *See also* new title "Mobility Engineering for the Severely Handicapped," in BPR 10-28, 10-29, 10-30
— Mobility Aids for the Severely Handicapped. A Status Report: Charles M. Scott and Ronald E. Prior 10-26(192-213)
Champion, Sherry
— Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects. Contractor Reports: P.P. Griffin, R. Shiavi, S. Champion, and F. Freeman (VA Hospital, Nashville, Tennessee) 10-30(217-223)
Character Recognition System *see* Optical Character Recognition (OCR)
Chargers
— Clinical Application Study of Externally Powered Upper-Limb

Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
Charles, Dean
— Implantable Neural Electrode. Recent Patents 10-28(258)
Chase, Michael H.
— Clinical Application of Electrode Implantation in the Human Body. Contractor Reports: M.H. Chase, and M. Babb (University of California, Los Angeles, Calif.) 10-21(147-148)
— Survey of Implanted Electrodes: M.H. Chase 10-22(259-260)
Check Writing Guide for the Blind
— Recent Patents: John E. Keitzer, and Betty J. Keitzer 10-27(208)
"Chestvibes"
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Types of ETA's 10-30(82-108)
— The Lindsay Russell E Model Pathsounder 10-30(82-84)
— Factory Modifications 10-30(84)
Chief of Blind Rehabilitation Russell C. Williams at VACO Retires
— Notes and News 10-24(277-278)
Children's Prostheses
— The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients with Myoelectric Control: Hannes Schmidl 10-27(17-42)
Childress, Dudley S.
— Editorial — Control Concepts in Prosthetics: D.S. Childress 10-23(1-3)
— The Lift Lock: A Device to Increase the Lifting Ability of Dual-Control Prostheses: L.E. Carlson and D.S. Childress 10-23(158-168)
— Prosthetics Research. Contractor Reports: R.G. Thompson and D.S. Childress (Northwestern University, Chicago, Illinois) 10-23(282-284) 10-24(218-219) 10-25(183-184) 10-26(285) 10-27(127-129) 10-28(135-138) 10-29(100-103) 10-30(176-178)
— A Search for Better Limbs; Prosthetics Research at Northwestern University: D.S. Childress, J.N. Billock, and R.G. Thompson 10-22(200-212)
Chin Control of Wheelchairs
— Chin Control of Wheelchairs
— VAPC Research Report 10-23(228-231)
— Chin Control Powered Swing Away
— VAPC Research Report 10-28(103-105)
— Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prostheses and Orthoses
— Contractor Reports: Johns Hopkins University
— Chin Wheelchair Controller with Swing-Away Feature also Controls Powered Manipulator via Optical Coupling . . . Is

Compatible with Mouthstick 10-29(109-114)
— Chin Controller Redesigned to Minimize Mechanism in Vicinity of the User's Face 10-30(185-190)
Chisholm, Donald
— Motorized Wheelchair. Recent Patents 10-22(528)
Cichiello, Frank
— Telecommunications System for the Hearing Impaired Utilizing Baudot-ASCII Code Selection. Recent Patents 10-25(258)
Clarke Carrier Corp., Fort Lauderdale, Florida
— Handi-Cup Beverage Carrier for Wheelchairs 10-30(147)
Cleland, Max
— Honored in 1977 Jefferson Award. Notes and News 10-28(244)
Clinical Application of Electrode Implantation in the Human Body
— Contractor Reports: M.H. Chase and M. Babb. University of California, Los Angeles, The Center for Health Science Brain Information Service, Los Angeles California 10-21(147-148)
Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, The VA Hand, and The VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
— Amputee and Clinic Team Reactions and Responses to the Experimental Devices 10-24(124-135)
— *See* entry under "Upper-Limb Prosthetics" for details
Clinical Gait Analyzer: Jacquelin Perry 10-22(188-192)
— Development of a Gait Analyzer 10-22(188-192)
Clinical Gait Analyzer
— Contractor Reports: J. Perry. The Professional Staff Association of the Rancho Los Amigos Hospital, Downey, California 10-21(149-150) 10-23(329 no report) 10-24(251-253) 10-25(214)
— Hardware Design 10-24(251)
— System Test 10-24(251-253)
Clinical Evaluation of a Sensory Feedback Device: the Limb Load Monitor. Gunilla Wannstedt and Rebecca L. Craik 10-29(8-49)
— Effectiveness of the LLM in Attaining Treatment Goals 10-29(21-24)
— Results of Treatment 10-29(22-24)
— Treatment Approaches 10-29(21-22)
— Types of Treatment Approaches and Modes of Device Feedback Used for Amputation and Hemiplegia Patients (graph) 10-29(23)
The Clinical Engineer and the Spinal-Cord-Injured Person: Peter C. Hofstra 10-22(37-40)
Clinical Application Study of Reading and Mobility Aids for the Blind
— Contractor Reports: G.M. Gillispie, W. De l'Aune, P. Gadbaw, C. Lewis (Eastern Blind Rehabilitation Center, VA Hospital, West

Haven, Connecticut) 10-21(170-173) 10-23(348-351) 10-24(271-274) 10-25(238-241) D. Garner 10-26(360-363) 10-27(196-198) 10-28(238-240) 10-29(164-167) 10-30(261-268)

Clinical Application Study of Reading and Mobility Aids for the Blind
— Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, A. Wood, (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California) 10-23(339-341) K. Wiley 10-24(267-268) 10-25(223-226) 10-26(354-357) 10-27(191, Report incorporated into article entitled "A Preliminary Followup Study of Electronic Travel Aid Users" pp. 82-91) S. Paul 10-29(171-173) 10-30(272-273)

Clinical Application Study of Reading and Mobility Aids for the Blind
— Contractor Reports: J.D. Malamazian, H. Lauer, and J.J. Whitehead. (Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois) 10-23(337-338) 10-24(264-265)

Clinical and Physiological Evaluation of Seat Cushions for the Paralyzed *see* Seat Cushions for the Paralyzed

Clinical Research with Cerebral Palsied Children
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)

Clinical Study of Mobility Aids for the Blind
— Contractor Reports: J.D. Malamazian, L.W. Farmer, and J.J. Whitehead. (Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois 10-25(219) 10-26(350-352) 10-27(187-190) 10-28(230-232) 10-29(167-169) 10-30(268-270)

Clinical Trials of Reading Machines for the Blind
— Contractor Reports: J.D. Malamazian and H. Lauer. VA Hospital, Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois 10-21(161-162) 10-23(338-339) 10-24(265-266) 10-25(221-222) 10-26(353-354) 10-27(190-191) 10-28(229-230) 10-29(170-171) 10-30(270-271)

Clippinger, Frank W., Jr.
— Prosthetics, Orthotics, and Sensory Aids Research Services. Contractor Reports: F.W. Clippinger (Comm. on Prosthetics Research and Development, National Research Council, Wash., D.C.) 10-25(178-179) 10-26(272-273)
— A Sensory Feedback System for an Upper-Limb Amputation Prosthesis: F.W. Clippinger, R. Avery, and B.R. Titus 10-22(247-258)
— A System to Provide Physiologic Sensation from an Upper-Limb Amputation Prosthesis. Contractor Reports: F.W. Clippinger, Jr. (Duke University Medical Center, Durham, North Carolina 10-21(141 no report) 10-23(315 no report)

Cloran, Arthur J.
— Telescoping Mouth Stick Developer, VAPC Research Report 10-21(93-95)
— Telescopic Stick for Paralytics. Recent Patents 10-22(529)
Closed Circuit Television
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, A. Wood, K. Wiley, and S. Paul (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California)
— CCTV 10-23(339-341)
— CCTV Evaluation 10-24(268) 10-25(224-225)
— Expanded Followup Study of CCTV Use 10-25(225-226)
Closed Circuit Television
— Closed Circuit Television (CCTV) Magnifiers: Loyal E. Apple (Western Blind Rehabilitation Center) 10-22(461-462)
— Experience with Closed Circuit Television in the Blind Rehabilitation Program of the Veterans Administration: Edwin B. Mehr, Alan B. Frost, and Loyal E. Apple (Western Blind Rehabilitation Center) 10-21(54-68)
Cochran, George Van B.
— Acceleration of Bone Healing by Electrical Stimulation: G.V.B. Cochran 10-22(291-294)
— Acceleration of Bone Healing by Electrical Stimulation. Contractor Reports: G.V.B. Cochran (St. Luke's Hospital Center, N.Y., N.Y.) 10-21(141-142) 10-23(315-318) 10-24(238-239) (Helen Hayes Hospital, W. Haverstraw, N.Y.) 10-25(208-209) 10-26(322 no report) 10-27(157-158) 10-28(179-180) (VA Hospital, Castle Point, N.Y.) 10-29(136) 10-30(209)
Cognodictor
— The Development and Evaluation of a Personal Reading Machine for the Blind. Contractor Reports: H.A. Mauch and G.C. Smith (Mauch Laboratories, Dayton, Ohio) 10-21(158-160)
— The Development of Personal Reading Machines for the Blind: Hans A. Mauch and Glendon C. Smith
— Cognodictor Breadboard Development 10-22(430-432)
— Cognodictor Features 10-22(429-430)
— Research and Development in the Field of Reading Machines for the Blind. Contractor Reports: H.A. Mauch and G.C. Smith (Mauch Laboratories, Dayton, Ohio) 10-23(336-337) 10-24(261-264) 10-25(218-219) 10-26(348-350)
— Cognodictor Development 10-26(348-350)
— Research and Development in the Field of Reading Machines for the Blind: Glendon C. Smith and Hans A. Mauch 10-27(61-71)
— Comparison of Hand-Held Probe and Page-Scanner Concepts in Design and in Use 10-27(62-67)

— Preprocessing and Interface Circuits 10-27(67-69)
— Probe Design 10-27(64-67)
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Optical Character-Recognition is Applied 10-26(146-147)
Cognodictor Reading Machines *see* also Mauch Laboratories, Reading Machines
Coiffet, Philippe
— Electrical Stimulation of Limbs—Part I Basic Studies, Part II—Open Loop Control of Muscular Contraction: P. Rabischong, F. Bonnel, E. Dombre, E. Peruchon, P. Coiffet, B. Fournier, and J. Brebic 10-22(261-290)
— Electrical Stimulation of Limbs—Part III. Joint Position Control: A. Fournier, E. Dombre, and P. Coiffet 10-25(5-24)
Collins, Dennis William
— Pivoted Artificial Limb with Spring Loaded Joint Lock. Recent Patents 10-24(285)
Colorado State University, Fort Collins, Colorado
— Control of an Artificial Upper-Limb in Several Degrees of Freedom. Contractor Reports: D. Graupe 10-21(139-141) 10-23(312-315) 10-24(236-238) 10-25(206-207) 10-26(320-323) 10-27(155-157) 10-28(178-179) 10-29(107-108) 10-30(182-184)
— Control of Upper-Limb Prostheses in Several Degrees of Freedom: Daniel Graupe 10-22(226-236)
— Development of a Hearing Aid with Independently Adjustable Subranges of its Spectrum Using Microprocessor Hardware. Contractor Reports: D. Graupe (Colorado State University) G.D. Causey (University of Maryland, College Park, Maryland, and VA Hospital Washington, D.C.) 10-23(351-352) 10-24(274-275) 10-25(241-242) 10-26(363-364) 10-27(199-200) 10-28(241-242) 10-29(178) 10-30(275-276)
Comfortcom
— VAPC Research Report 10-23(241-242)
Committee on Blind Rehabilitation
— VA Coordinating Committee on Blind Rehabilitation Held First Meeting March 27, 1978. Notes and News 10-30(282)
Committee on Orthotics and External Prosthetics
— ASTM Forms Committee on Orthotics and External Prosthetics Notes and News 10-22(522)
Committee on Prosthetics Research and Development and Committee on Prosthetic-Orthotic Education, National Research Council, National Academy of Sciences, Washington, D.C.
— Contractor Reports: Colin A. McLaurin 10-21(109-118) 10-23(265-279) James Reswick 10-24(209-214) Frank W. Clippinger

10-25(178-179) 10-26 (272-273)
— Aids for the Deaf-Blind 10-24(213)
— Clinical Evaluation of the Ortho-Walk Pneumatic Lower-Limb Orthosis 10-24(212)
— Committee on Prosthetic-Orthotic Education 10-21(114-115) 10-23(272-275)
— Compilation of a Directory of Locomotion Laboratories 10-24(211)
— Cybernetics Research Institute (CRI) Communications Systems for the Disabled 10-23(269-270)
— Future Plans 10-23(270-271)
— Governmental Relationships 10-22(486)
— Low Vision Aids 10-24(213)
— Maintaining Liaison with Educational Programs 10-24(210)
— Newsletter 10-24(211)
— Operation of Informal Clearinghouse for Information of Rehabilitation Engineering 10-24(209-210)
— Operation of the Winnipeg Information Retrieval System 10-24(211)
— Operational Concept 10-22(485-486)
— Organization of CPRD 10-22(483-485)
— Organization of Research Program 10-22(478-480)
— Other Activities 10-26(273)
— Panel on Evaluation of Inkprint Readers 10-24(214)
— Panel on Hearing-Aid Performance 10-24(212)
— Participation in the American Society for Testing and Materials (ASTM) Committee F-19 on Orthotics and External Prosthetics 10-24(210)
— Present Program Organization 10-22(482-483)
— Prosthetics Education Program 10-22(481-482)
— Public Law 729 10-22(480)
— Publications 10-21(117-118) 10-23(278-279)
— Reports and Activities Completed 10-26(272-273)
— Reports in Progress 10-24(214) 10-26(273)
— Review of Proposals for Research and Education 10-24(209-210)
— Revision of "Rehabilitation Engineering — A Plan for Continued Progress" 10-24(210)
— Roster of Amputee Clinics 10-24(211)
— Special Meetings and Activities 10-21(115-117) 10-23(275-278)
— Subcommittee on Child Prosthetics Problems 10-21(110) 10-23(271-272)
— Subcommittee on Design and Development 10-21(112)
— Subcommittee on Evaluation 10-21(112-114) 10-23(267-269)

— Subcommittee on Fundamental Studies 10-21(109-110) 10-23(265-266)
— Subcommittee on Sensory Aids 10-21(110-111) 10-23(266-267)
— Suction Socket "Schools" 10-22(480)
— Task Force on Rehabilitation Engineering for the Hearing Handicapped (IFFHH) 10-24(213-214)
— Workshop on Clinical Instruments for Gait Analysis 10-24(210)
— Workshop on Environmental Controls for Quadriplegic Patients 10-24(212)
— Workshop on Functional Electrical Stimulation 10-24(211)
— Workshop on Lower-Limb Prosthetics 10-24(211-212)
— Workshop on Low Vision Mobility 10-24(212-213)
— The Role of the Committee on Prosthetic Research and Development and the Committee on Prosthetic-Orthotic Education, A. Bennett Wilson 10-22(478-486)
— Governmental Relationships 10-22(486)
— Operational Concept 10-22(485-486)
— Organization of CPRD 10-22(483-485)
— Organization of Research Program 10-22(478-480)
— Present Program Organization 10-22(482-483)
— Prosthetics Education Program 10-22(481-482)
— Public Law 729 10-22(480)
— Suction-Socket "Schools" 10-22(480)
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Stereotoner Evaluation Study 10-26(148-154)
— CPRD Role 10-26(148-151)
Commode Chairs
— Wayne Chair 10-25(159-161)
Communication Aids
— Brailling Device Gives Blind Worker Access to Computer and Communications Systems. Notes and News 10-25(250-251)
— Special Phone Services Booklet. Notes and News 10-23(354)
— *see also* VAPC Research Reports-Spinal Cord Injury Rehabilitation-Communication Aids
Communication Devices
— Control and Communication Devices for the Severely Disabled: Ronald Arroyo 10-25(55-68)
— VAPC Communicator 10-25(63)
— PortaPrinter 10-25(63-65)
— Possum Typewriter 10-25(66-67)
— Strip Printer 10-25(65-66)
— Tufts Interactive Communicator 10-25(65)

Communication Devices and Communicators *see* Environmental Control and Communication Systems
Commutron Ltd., Ontario, Canada
— Touch-Operated Selector Control (TOSC) 10-26(220-222)
Compliance Testing
— SACH Feet 10-23(258)
Composite Endoskeletal Structures
— VAPC Research Report 10-21(70-72)
Comprehensive Care for People with Arthritis: A Multidisciplinary Symposium Announced
— Notes and News 10-30(283)
Compression
— A Device Designed to Approximate Shear Forces On Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— Editor's Note 10-30(36-37)
Compression Amplification and Speech Intelligibility in Noise
— Contractor Reports: J.J. Sung. Audiology and Speech Pathology Service, VA Hospital, Pittsburgh, Pennsylvania 10-27(199) 10-28(240-241) 10-29(185-186, A Final Report)
Compression Hearing Aids
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Test and Selection Program 10-25(121-122)
Compression Sheath for Below-Knee Amputated Limbs
— Recent Patents: Jan Prahl 10-27(208)
Compudrive Corp., North Billerica, Mass.
— Orbidrive "Powered Wheel" for Wheelchairs 10-26(230-232)
Conductive Hearing Loss
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. A Final Report: Raymond T. Carhart and Lamar Young 10-26(9-45)
— Discrimination of Speech in Quiet and in Noise 10-26(10-11)
Conference on Aging and Blindness
— First National Conference. Notes and News 10-23(354)
Conference and Exhibition on Bio-Engineering
— 4th Conference. Calendar of Events 10-26(385) 10-27(216)
Conference on Engineering in Medicine and Biology
— Annual Conference, ACEMB. Calendar of Events 10-28(265) 10-29(201) 10-30(300)
— Annual Conference, ACEMB. Calendar of Events 10-21(186) 10-22(537) 10-23(365)
— Annual Conference, ACEMB. Calendar of Events 10-26(385) 10-27(216)
— Meeting, ACEMB. Calendar of Events 10-23(366) 10-24(293,

294) 10-25(265-266) 10-26(385, 386) 10-27(216)
Conference on Human Factors in Clinical Medicine (Design and Clinical Efficacy of Physical and Sensory Prosthetics)
— Calendar of Events 10-30(300)
Conference on Materials for Use in Medicine and Biology. Mechanical Properties of Biomaterials.
— Bioceramics Symposium. Calendar of Events 10-29(201)
Conference on Medical and Biological Engineering
— 11th International Conference. Calendar of Events. 10-23(366) 10-24(293)
Conference on Rehabilitation Engineering
— Interagency Conference. Notes and News 10-30(283-284)
Conference on Systems & Devices for the Disabled.
— 4th Annual Meeting. Calendar of Events 10-26(384)
Consolidated Industries, Inc., Lincolnton, North Carolina
— Burris Spinal Cord Injury Recliner 10-23(238-239)
Constant Current Power Pack for Bone Healing and Method of Use
— Recent Patents: Carl T. Brighton, Zachary B. Friedenberg, and William Redka 10-23(358)
"Consumer Rights for Disabled Citizens"
— Published by New York City's Department of Consumer Affairs. Notes and News 10-26(373-374)
Continence
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Electrical Stimulation for Bladder Control 10-23(92-96)
Contracted Testing Services
— VAPC Research Report 10-24(200)
Control of an Artificial Upper-Limb in Three Degrees of Freedom
— Contractor Reports: D. Graupe. Colorado State University, Department of Electrical Engineering, Fort Collins, Colorado 10-21(139-141) 10-24(236-238)
Control of an Artificial Upper Limb in Several Degrees of Freedom
— Contractor Reports: D. Graupe. Colorado State University, Department of Electrical Engineering, Fort Collins, Colorado 10-23(312-315) 10-25(206-207) 10-26(320-322) 10-27(155-157) 10-28(178-179) 10-29(107-108) 10-30(182-183)
— Analytical Work 10-30(183)
— Equipment Modification 10-30(183)
— Modified Myoelectric System 10-25(207)
— Preliminary Clinical Study 10-30(182-183)
— *See also* A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals Using Microprocessors: Daniel Graupe, A.A.M. Beex, W.J. Monlux, and I. Magnussen 10-27(4-16)

Control and Communication Devices for the Severely Disabled: Ronald Arroyo 10-25(55-68)
— Communication Devices 10-25(62-67)
— PortaPrint 10-25(63-65)
— Possum Typewriter 10-25(66)
— Strip Printer 10-25(65)
— Tufts Interactive Communicator 10-25(65)
— VAPC Communicator 10-25(63)
— Environmental Control Systems 10-25(55-62)
— Scope Voice-Operated Typewriter and Environmental Control 10-25(60-62)
— VAPC Home Model Environmental Control System 10-25(58-59)
— VAPC Hospital Model Environmental Control System 10-25(55-58)
— VAPC Remote Station Environmental Control 10-25(59)
Controlled Early Ambulation of Heel Surface Defects Covered by Pedicle Flaps in Lower-Limb Amputees: James H. Herndon, Alcide M. LaNoue, and Stanley P. Frileck 10-21(9-22)
— Case Reports 10-21(12-18)
— Discussion 10-21(18-22)
— Method 10-21(10-12)
Controlled Environment Treatment
— Below-Knee Amputation With Immediate Postoperative Fitting of Prosthesis. Contractor Reports: W.S. Moore, A.D. Hall, and L.A. Wilson (VA Hospital, San Francisco, California) 10-21(128) 10-23(300) 10-24(225, no report) 10-25(200, no report) 10-26(307) 10-27(142, no report) 10-28(156, no report) (VA Hospital, Tucson, Arizona) 10-29(124-125) 10-30(199)
— *See* "Below Knee Amputation" for details
Controlled Environment Treatment for Limb Surgery and Trauma (a Preliminary Report): Ernest M. Burgess, and Larry R. Pedegana 10-28(16-57)
— Application of CET 10-28(23-25)
— Pressures, Cycle Times, and Temperature Settings 10-28(24-25)
— Background 10-28(17-20)
— Background Leading to Development of Investigation 10-28(18-20)
— Background on Wound Healing 10-28(17-18)
— CET MK II Unit 10-28(47-48)
— CET Trial Center Reports 10-28(50-54)
— Conclusions Reported From Investigating Centers 10-28(53)
— Advantages of CET 10-28(53)
— Disadvantages of CET 10-28(53)

— Description of Method and Equipment 10-28(20-23)
— Development of Related Management Systems 10-28(48-50)
— Experience on First 20 Cases 10-28(25-47)
— Case Studies 10-28(32-47)
— Edema Control 10-28(30-31)
— Hematoma 10-28(30)
— Infection 10-28(30)
— Pain 10-28(31)
— Time From Surgery to Definitive Prosthetic Prescription 10-28(32)
— Wound Healing Progress 10-28(25-29)
— Summary of CET Equipment Malfunctions 10-28(53)
Controlled Environment Treatment *see also* Postsurgical Wound Management
Control Systems for the Handicapped *see* Environmental Control and Communication Systems
Control of Upper-Limb Prostheses in Several Degrees of Freedom: Daniel Graupe 10-22(226-236)
— EMG-Actuated Subsystem 10-22(228-231)
— Toe-Actuated Control 10-22(227-228)
ConVaid Co., Palos Verdes, California
— ConVaid Mobile Prone Stander 4000, VAPC Research Report 10-25(156-158)
ConVaid Mobile Prone Stander 4000
— VAPC Research Report 10-25(156-158)
Conventional Cable-Operated Prostheses with Add-On Power Assist
— Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior and Charles M. Scott 10-24(43-50)
Cooper, Donald C.
— Mobility and Reading Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports: L.E. Apple, R. Bennett, W. Ekstrom, and D.C. Cooper (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, Calif.) 10-21(163-165)
Cooper, Franklin S.
— The Current Status of Reading Machine Research at Haskins Laboratories: F.S. Cooper 10-22(439-442)
— Elected to Membership in the National Academy of Engineering. Notes and News 10-26(374)
— Receives the Silver Medal in Speech Communication. Notes and News 10-24(279-280)
— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: F.S. Cooper, J.H. Gaitenby, I.G. Mattingly, P.W. Nye, and G.N. Sholes (Haskins Laboratories, Inc., New Haven, Conn.) 10-21(153-158) A.M. Liberman 10-23(331-335) 10-24(256-261) 10-25(216-218) F. Ingemann, and L. Shockey

10-26(344-348) 10-27(185-187) A. Levitt 10-28(225-228) 10-29(173-178) 10-30(273-275)
Corwin, Merton D.
— Method and Apparatus for Programming a Computer Operated Robot Arm. Recent Patents 10-26(376)
Cosmetic Covers
— Cosmetic Covers for Lower-Limb Prostheses: Thomas A. Krouskop, Paul H. Newell, Jr., and Lewis A. Leavitt 10-22(411-414)
— Cosmetic Cover Development and Fabrication 10-22(412-414)
— Cosmetic Covers for Lower-Limb Prostheses: Charles W. Radcliffe 10-22(415-416)
— Cosmetic Covers for Lower-Limb Prostheses: Hans A. Mauch 10-22(410)
— Prosthetic Skin, George Washington University 10-26(217)
— Urethane Foam Shank Covers (Prefabricated) VAPC Research Report 10-21(73)
Cosmetic Restoration
— The First International Symposium On Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
Counter-Force Elbow Orthosis
— VAPC Research Report 10-25(138-141) 10-26(218-220) 10-28(96-97)
Covalt, Donald A. (1906-1977)
— Biography of. Notes and News 10-28(253-255)
Cowan, James W.
— Electrically Driven Hand Orthosis Device for Providing Finger Prehension. Recent Patents 10-27(208)
Cozier, J. Kenneth
— Selected as 1975 Migel Medal Winner. Notes and News 10-24(276-277)
Craik, Rebecca L.
— Clinical Evaluation of a Sensory Feedback Device: The Limb Load Monitor: G. Wannstedt and R.L. Craik 10-29(8-49)
Cranberg, Lawrence
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Laser Canes and Other Aids Using Optical Principles 10-30(87-108)
— United States Army Signal Corps Obstacle Detector 10-30(87-88)
Crapanzano, Russell S.
— Gravity Activated Prosthetic Device. Recent Patents 10-22(528)
Crawford, G.E., Jr.
— Development of a Wheelchair Using a Myoelectric Control System. Contractor Reports: A.B. Rossier, M. Sarkarati, and G.E.

Crawford, Jr. (VA Hospital, West Roxbury, Mass.) 10-29(158-159) 10-30(255-257)
Crook (Cane Handle)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Specifications 10-30(48-49)
— The C-5 Laser Cane 10-30(91-96)
CROS (Contralateral Routing of Hearing Aid Signals) *see* BICROS
Crozier Chair, Proprietary Ltd., Victoria, Australia
— Crozier Transfer System, VAPC Research Report 10-24(188-190)
Crutches *see* Canes and Walking Aids
Crutch Tip with Insert
— Recent Patents: Ted F. Urban 10-21(177)
Crutch Tips
— Slipping Cane and Crutch Tips Part I — Static Performance of Current Devices: Leon Bennett and Eugene F. Murphy 10-28(71-90)
Cunningham, Don M.
— Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion. Contractor Reports: C.W. Radcliffe, H.D. Eberhart, D.M. Cunningham, and J.M. Morris (Biomechanics Lab., Univ. of California, Berkeley, Calif.) 10-21(123-126) 10-23(285-290) 10-24(220-222) 10-25(194-198) 10-26(288-301) 10-27(132-136) 10-28(142-152) L. Lamoreux 10-29(120-122) 10-30(193-196)
— Variable-Height-Powered Wheelchair for the Quadriplegic Driver: D.M. Cunningham 10-22(337-369)
Current States of the Research Effort at Veterans Administration Hospital, Hines, Illinois: John D. Malamazian and Harvey Lauer 10-22(451-457)
Current State of the VA Research Effort at the Western Blind Rehabilitation Center: Loyal E. Apple 10-22(458-462)
The Current Status of the Future Considerations for Environmental Control System: Robert Green 10-22(310-325)
Current Status — Prosthetic Materials for Maxillofacial Reconstruction: James W. Schweiger and John F. Lontz 10-22(408-409)
The Current Status of Reading Machine Research at Haskins Laboratories: Franklin S. Cooper 10-22(439-442)
Curry, Paul F.
— Wheel Chair. Recent Patents 10-23(360)
Cushions
— Seat Cushions for the Paralyzed. Contractor Reports: Bok Y. Lee and Leon Bennett (VA Hospital, Castle Point, New York, and VA Prosthetics Center, New York, New York) 10-29(160-161) 10-30(258)
— Seating Systems for Body Support and Prevention of Tissue

Trauma. Contractor Reports: I. Perkash (VA Hospital, Palo Alto, California) 10-29(162-163) W. Motloch (Stanford University, Children's Hospital, Palo Alto, California) 10-30(258-260)
— Test Standards for Wheelchair Cushions 10-25(171)
— Title originally "Clinical and Physiological Evaluation of Seat Cushions for the Paralyzed"
— *see also* Wheelchair Cushions
Cycle Test
— Physical Response of SACH Feet Under Laboratory Testing: R. L. Daher 10-23(4-50)
— Test Apparatus 10-23(4-7)

D

Dabney, Douglas H.
— Saddle Stirrup for Use by a Leg Amputee. Recent Patents 10-23(359)
Daher, Richard L.
— Physical Response of SACH Feet Under Laboratory Testing: R.L. Daher 10-23(4-50)
— Prosthetic Foot. Recent Patents 10-30(290)
D'Albe's Exploring Optophone
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Electronic Travel Aids (ETA's): History and Development 10-30(75-108)
— Background 10-30(75-77)
Darling, Nancy C.
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, and A. Wood (Western Blind Center, VA Hospital, Palo Alto, Calif.) 10-23(339-341) K. Wiley 10-24(267-268) 10-25(223-227) 10-26(354-356) 10-27(191) (For Report of Period Covered by BPR 10-26 and 10-27, *see* article "A Preliminary Followup Study of Electronic Travel Aid Users") 10-28(232-235) 10-29(171-173) 10-30(272-273)
— A Preliminary Followup Study of Electronic Travel Aid Users: N.C. Darling, G.L. Goodrich, and J.K. Wiley 10-27(82-91)
Davis, Cheryl A.
— Program Associate of AAAS Project on the Handicapped in Science. Notes and News 10-28(248)
Davis, Ross M.
— Evaluation of Electrical Stimulation as a Treatment for the Re-

AD-A070 587 VETERANS ADMINISTRATION WASHINGTON DC DEPT OF MEDICI--ETC F/G 5/2
BULLETIN OF PROSTHETICS RESEARCH. SPRING 1979,(U)
1979 E F MURPHY
UNCLASSIFIED BPR-10-31 NL

4 OF 6
AD
A070587



duction of Spasticity: R. Davis and J.W. Gesink 10-22(302-309)
— Spinal Cord Injury Studies: Paralysis, Spasticity, and Pain. Contractor Reports: R.M. Davis (VA Hospital, Miami, Florida) 10-21(146-147)
— Transcutaneous Nerve Stimulation for Treatment of Pain in Spinal-Cord-Injured Patients: R. Davis and R. Lentini 10-22 (298-301)
Davis Suspension System
— VAPC Research Report 10-26(242)
Daw Industries, Minneapolis, Minnesota
— Daw Stump Sock System 10-27(94)
Deaf Seek "Full Citizenship"
— Notes and News 10-25(253)
Declaration of Rights for the Deaf-Blind
— Adopted by Helen Keller World Conference. Notes and News 10-28(245-246)
Decubitus Ulcers (*see also* Bedsores, Pressure Sores).
— A Device Designed to Approximate Shear Forces On Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— Abstract 10-30(37)
— Design Concepts 10-30(38-39)
— Flapper Valve Design 10-30(39-42)
— Flapper Valve Physical Model 10-30(42-45)
— The Physical Shear Gage 10-30(45-46)
— Edge Light: A New Approach to Studying the Microvascularization of the Skin: Jeanette F. Kissinger, Phyllis J. Verhonick, and David W. Lewis 10-29(65-78)
— An Attempt to Correlate Visual Contact Patterns with Interface Pressure Data (Illustrated) 10-29(68-76)
— Plexiglas Rigid Transparent Support Surface 10-29(68-76)
— References 10-29(77-78)
— Review of Techniques 10-29(66-68)
— Interface Pressures 10-29(67)
— Other Methods 10-29(67-68)
— Thermography 10-29(66)
— Thermographical Investigation of Decubitus Ulcers: Richard S. Trandel, David W. Lewis, and Phyllis J. Verhonick 10-24(137-155)
Decubitus Ulcers Prevention
— Seat Cushions for the Paralyzed. Contractor Reports: B.Y. Lee and L. Bennett (VA Hospital, Castle Point, New York, and VA Prosthetics Center, New York, New York) 10-29(160-161) 10-30(258)

— Seating Systems for Body Support and Prevention of Tissue Trauma. Contractor Reports: Inder Perkash (VA Hospital, Palo Alto, California) 10-29(162-163) Wallace Motloch (Stanford University, Children's Hospital, Palo Alto, California) 10-30(258-260)

Decubiti, Decubitus Ulcers, *see also* Bed Sores, Blood Flow, Pressure Sore Prevention and Treatment Systems

Deeg, Emil W.

— Artificial Intraocular Lens. Recent Patents 10-30(287)

De l'Aune, William R.

— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: G. M. Gillispie, W. De l'Aune, P. Gadbaw, and C. Lewis (Eastern Blind Rehab. Center, VA Hospital, West Haven, Conn.) 10-21(170-173) 10-23(348-351) 10-24(271-274) 10-25(238-241) D. Garner 10-26(360-363) 10-27(196-198) 10-28(238-240) 10-29(164-167) 10-30(261-268)

— Research at the Eastern Blind Rehabilitation Center: G.M. Gillispie and W. De l'Aune 10-22(463-468)

Dennison, Tonnés, 1894–1976

— Biography of. Notes and News 10-28(251-253)

A Description of the Kurzweil Reading Machine and a Status Report on Its Testing and Dissemination: Aaron Kleiner and Raymond C. Kurzweil 10-27(72-81)

Design Changes in Mechanical Adaptive Automotive Hand Control Systems

— VAPC Research Report 10-24(198)

Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion

— Contractor Reports: Charles W. Radcliffe, Donald M. Cunningham, and James M. Morris. University of California, Berkeley, Biomechanics Laboratory, Berkeley, California 10-21(123-126) 10-23(285-290) 10-24(220-222) 10-25(194-198) 10-26(288-301) 10-27(132-136) Larry Lamoreux 10-28(142-152) 10-29(120-122) 10-30(193-196)

Design Training Program in Health Care Systems

— Notes and News 10-21(175)

Developing a Permanently Attached Artificial Limb: C. William Hall 10-22(144-157)

— *See* "Skeletal Extension Development"

Development (initiated by Clinic Team)

— VAPC Research Report 10-24(206)

The Development of Artificial Limbs for Lower Limbs: Hans A. Mauch 10-22(158-166)

Development of Correspondence Courses for Personal Reading Aids for the Blind

— Contractor Reports: D.W. Hathaway and M. Butow. The Hadley School for the Blind, Winnetka, Illinois 10-21(162-163)
Development and Evaluation of Advanced Automotive Adaptive Equipment *see* Automotive Adaptive Equipment, Automotive Driving Aids
Development and Evaluation of a New Artificial Larynx
— Contractor Reports: L.P. Goldstein, H. Rothman, and C. Oliver. VA Hospital, Gainesville, Florida 10-29(186) 10-30(278-279)
Development of a Hearing-Aid System With Independently Adjustable Subranges of its Spectrum Using Microprocessor Hardware
— Contractor Reports: Daniel Graupe, Colorado State University, Department of Electrical Engineering, Fort Collins, Colorado; and G. Donald Causey, University of Maryland, BioCommunications Laboratory, College Park, Maryland 10-23(351-352) 10-24(274-275) 10-25(241-242) 10-26(363-364) 10-27(199-200) 10-28(241-242) 10-29(178-179) 10-30(275-276)
The Development and Evaluation of a Personal Reading Machine for the Blind
— Contractor Reports: H.A. Mauch and G.C. Smith. Mauch Laboratories, Dayton, Ohio 10-21(158-160)
The Development of Improved Techniques for the Analysis of Hearing-Aid Performance
— Contractor Reports: G. Donald Causey, Earleen Elkins, and Lucille Beck. University of Maryland, BioCommunications Laboratory, College Park, Maryland 10-23(342-346) 10-24(269, no report) 10-25(231-233) 10-26(357-360) also Jerry L. Punch, and Howard C. Schweitzer. VA Hospital, Washington, D.C. 10-27(191-196) 10-28(235-238) 10-29(179-185) 10-30(276-278)
The Development of Living Skills by the Handicapped: Robert A. Weisgerber 10-22(436-438)
The Development of Personal Reading Machines for the Blind: Hans A. Mauch, and Glendon C. Smith 10-22(427-432)
Development of Refined Fitting Procedures for Lower-Limb Prostheses: Augusto Sarmiento 10-22(114-132)
Development of Refined Fitting Procedures for Lower-Limb Prosthesis—Case Studies of Applied Research in Orthotics and Prosthetics
— Contractor Reports: Augusto Sarmiento, Newton C. McCollough, III, William F. Sinclair. University of Miami School of Medicine, Department of Orthopaedic and Rehabilitation, Miami, Florida 10-21(136-137) 10-23(310-311) Loren L. Latta 10-24(234-235) 10-25(204) 10-26(317) Fred R. Hampton 10-28(162-178, A Final Report)
Development of Standards for Van Wheelchair Lifts
— VAPC Research Report 10-25(169)

Development of Test Procedures for Evaluation of Binaural Hearing Aids
— Contractor Reports: R. Carhart, and W.O. Olsen. Northwestern University School of Speech, Evanston, Illinois 10-21(165-166) L. Young 10-23(341-342) 10-24(268-269) 10-25(227-231) 10-26(356-357, Report incorporated into article as a Final Report under same title, pp. 9-45)
Development of Test Procedures for Evaluation of Binaural Hearing Aids. A Final Report: Raymond T. Carhart and Lamar Young 10-26(9-45)
Development of a Wheelchair Using a Myoelectric Control System
— Contractor Reports: A.B. Rossier, M. Sarkarati, and G.E. Crawford. VA Hospital, West Roxbury, Massachusetts 10-29(158-159) 10-30(255-257)
A Device Designed to Approximate Shear Forces on Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
Device for the Determination and the Automatic Real-Time Computation of the Parameters of Man's Stability of Stance:
— Recent Patents: Yurig V. Terekhov 10-25(257)
Device for Promoting Formation of Bone Material
— Recent Patents: Werner Kraus 10-26(375)
Device for Sensing and Warning of Excessive Ambulation Force
— Recent Patents: Erich A. Pfeiffer 10-21(177)
deWijn, Joost Robert
— Mixture for Anchoring Bone Implants. Recent Patents 10-30(290)
Diabetic Blind
— *See* SNIPAS Glucose Analyzer
Dialog Systems, Cambridge, Mass.
— Voice Recognition System 10-23(248)
Diagnostic Electrodes
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
Diamondhead Corp., Mountainside, New Jersey
— Mobilizer Powered Patient Transfer Device 10-27(111-112)
Dickey, Herbert C.
— Electrical Switch for Use by the Disabled. Recent Patents 10-30(288)
DiGiulio, Mario
— Appliance for Foot Orthosis. Recent Patents 10-30(287)
Direct Translation Mode for Reading Machine for the Blind *see* Probe for Reading Machine for the Blind.
Directional Hearing Aids
— The Hearing-Aid Program of the Veterans Administration:

Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Test and Selection Program 10-25(121-122)
— *See also* Development of Test Procedures for Evaluation of Binaural Hearing Aids, Development of Improved Techniques for the Analysis of Hearing Aid Performance. Detailed Entries under "Hearing Aids"
Directory of Scientists with Handicapping Conditions
— Notes and News 10-29(188)
Discrimination Process
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Data Treatment and Analysis 10-30(13-19)
Distance Detection by the Blind
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Understanding the Characteristics of the Distance Aid 10-26(84-88)
— Comments on Durability of Distance Aids 10-26(88)
Distance Visual Efficiency
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Introduction 10-26(49-50)
"Distant Early Warning"
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Electronic Travel Aids (ETA's): History and Development 10-30(75-108)
— Functions Performed by ETA's 10-30(77-78)
— Benefits from ETA's 10-30(78)
Dixon, Malcolm
— An Occipito-Zygomatic Cervical Orthosis Designed for Emergency Use-A Preliminary Report: G. Rubin, M. Dixon, and J. Bernknopf 10-29(50-64)
Dixon, Malcolm
— Orthotics: G. Rubin and M. Dixon 10-22(26-36)
Dog Guide
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Electronic Travel Aids (ETA's): History and Development 10-30(75-108)
— Definition and Purpose 10-30(77)
— A Preliminary Followup Study of Electronic Travel Aid Users: N.C. Darling, G.L. Goodrich, and J.K. Wiley 10-27(82-91)
— Now, "Hearing Ear Dogs" for the Deaf. Notes and News 10-28(247-248)
Dokoupil, Ludvik

— Apparatus for the Identification of Size Numbers of Right and Left Lasts. Recent Patents 10-30(287)
Dombre, Etienne
— Electrical Stimulation of Limbs: P. Rabischong, F. Bonnel, E. Dombre, E. Peruchon, P. Coiffet, B. Fournier, and J. Brebic-Part I-Basic Studies, Part II-Open Loop Control of Muscular Contraction 10-22(261-290)
— Electrical Stimulation of Limbs-Part III. Joint Position Control: E. Dombre and P. Coiffet 10-25(5-24)
Dorsal Column Stimulation for the Relief of Pain
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Dorsal Column Stimulation for the Relief of Pain 10-23(86-89)
Double-Wheel Automotive Hand Control System
— Recent Patents: Anton J. Reichenberger 10-30(288)
Double-Wheel Concept
— Automotive Driving Aids 10-23(253-254)
— VAPC Electro-Hydraulic Servo Control (Automotive) 10-24(196-198)
Douroux, Jean
— Methods for Investigating Internal Physiological Phenomena. Recent Patents 10-30(289)
Drake, Samuel H.
— Method and Apparatus for Six Degree of Freedom Force Sensing. Recent Patents 10-30(289)
Drive for an Orthosis or a Prosthesis
— Recent Patents: Alfred Zadina 10-30(288)
Driver Safety in Modified Vans: Charles M. Scott 10-22(377-387)
— Control Systems 10-22(377-378)
— Driver Seating 10-22(379)
— Driver's Seat Requirements 10-22(379-387)
— Introduction 10-22(377)
Driving Aids *see* Automotive Driving Aids
Driving Seats for Vans
— VAPC Research Report 10-23(257-258)
Dual-Control Prostheses
— The Lift Lock: A Device to Increase the Lifting Ability of Dual-Control Prostheses: Lawrence E. Carlson and Dudley S. Childress 10-23(158-168)
Dudley Controls, Ltd., Aylesbury, Great Britain
— Motorized Wheels, VAPC Research Report 10-21(94-97)
Duke University Medical Center, Durham, North Carolina
— A Sensory Feedback System for an Upper-Limb Amputation Prosthesis: Frank W. Clippinger, Roger Avery, and Bert R. Titus 10-22(247-258)

— A System to Provide Physiologic Sensation from an Upper-Limb Amputation Prosthesis. Contractor Reports 10-21(141) 10-23(315)
Duphar Life Lift
— VAPC Research Report 10-27(114) 10-30(133)
Durability
— Physical Response of SACH Feet Under Laboratory Testing: R. L. Daher 10-23(4-50)
Duran, Edward N.
— Subminiature Insertable Force Transducer. Recent Patents 10-26(376)
Durometer Test
— Physical Response of SACH Feet Under Laboratory Testing: R. L. Daher 10-23(4-50)
— Test Apparatus 10-23(4-7)
Dyck, W.R.
— A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W.R. Dyck, S. Onyshko, D.A. Hobson, D.A. Winter, and A.O. Quanbury 10-23(169-186)
Dynamic Analysis of Gait (Appendix)
— A Kneeless Leg Prosthesis for the Elderly Amputee, Advanced Version: Rahamin Seliktar and R. M. Kenedi 10-25(97-119)
Dyson, Reginald
— Body Support Means. Recent Patents 10-27(208)

E

Ealing Corp., South Natick, Mass.
— New Ealing Reader 10-27(102-103)
— Saltus Reading System (formerly Ealing Reader) 10-29(83-85) 10-30(123-124)
Early-Intervention
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Early-Intervention Training Suggestions 10-26(67-74)
Eberhart, Howard D.
— Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion. Contractor Reports: C.W. Radcliffe, H.D. Eberhart, D.M. Cunningham, and J.M. Morris (University of California, Berkeley, Calif.) 10-21(123-126)
— Selected to Membership by National Academy of Engineering. Notes and News 10-27(204)

Echo-Ranging Cues
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Advantages of the Long Cane 10-30(49-50)
Edco-Hemi Walker
— VAPC Research Report 10-26(244)
Edco-Matic Chair
— VAPC Research Report 10-26(251)
Edco/Pasco, Inc., Passaic, New Jersey
— Pyramid Folding Quad Cane (Illust.) 10-28(105-106)
Edco Surgical Supply Co., Inc., Passaic, New Jersey
— Edco-Matic Adjustable Chair with Table 10-26(251-252)
— Manufacturer, Edco-Hemi Walker 10-26(244)
Edema
— Controlled Environment Treatment for Limb Surgery and Trauma (a Preliminary Report): Ernest M. Burgess, and Larry R. Pedegana 10-28(16-57)
— A Proposed Technique for the Postoperative Monitoring of Skin Tension in Below-Knee Amputees: Ernest M. Burgess, Craig A. Spolek, and A. James Moore, Jr. 10-28(4-15)
Edema *see also* Postsurgical Wound Management
Edge Light: A New Approach to Studying the Microvascularization of the Skin: Jeanette F. Kissinger, Phyllis J. Verhonick, and David W. Lewis 10-29(65-78)
— An Attempt to Correlate Visual Contact Patterns with Interface Pressure Data (Illustrated) 10-29(68-76)
— Plexiglas Rigid Transparent Support Surface 10-29(68-76)
— References 10-29(77-78)
— Review of Techniques 10-29(66-68)
— Interface Pressures 10-29(67)
— Other Methods 10-29(67-68)
— Thermography 10-29(66)
Editorials
— ". . . And Sensory Aids II": Howard Freiberger 10-26(1-8)
— A Basic Theme of Cooperation: Eugene F. Murphy 10-22(1-4)
— Control Concepts in Prosthetics: (Guest Editor) Dudley S. Childress 10-23(1-3)
— The First Ten Years — An Index: Earl A. Lewis 10-21(1-2)
— Functional Electrical Stimulation-Neural Prosthesis for the Disabled: (Guest Editor) James B. Reswick 10-25(1-4)
— The Importance of Amputation-Level Determination: (Guest Editor) Wesley S. Moore 10-28(1-3)
— ISPO-International Key to the Future in Aiding the Handicapped: Anthony Staros 10-27(1-3)
— Rehabilitative Engineering — A New Era: Vernon L. Nickel 10-30(1-7)

— Technology Transfer: Eugene F. Murphy 10-29(1-7)
— The Wheel Keeps Turning: (Guest Editor) John Lyman 10-24 (1-2)
Ejercito, E.
— Hemodynamic Evaluation of Postoperative and Preoperative Amputees. Contractor Reports: B.Y. Lee, F.S. Trainor, J.L. Madden, and E. Ejercito (VAH, Castle Point, N.Y.) 10-21(142-143) D. Kavner 10-25(210-211) 10-26(322-323) 10-27(158-161) 10-29(125-127)
Ekstrom, William
— Mobility and Reading Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports: L.E. Apple, R. Bennett, W. Ekstrom, and D.C. Cooper (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, Calif.) 10-21(163-165)
Elbow Component
— A Versatile Joint Rotation Device for Externally Energized Upper-Limb Prostheses: Paul Meadows and John Lyman 10-24 (38-42)
Elbow Control System
— Position Control of Above-Elbow Prostheses. Contractor Reports: L.E. Carlson (University of Colorado, Boulder, Colorado)
— Extended Physiological Proprioception (EPP) System 10-29 *(108-109) 10-30(184-185)*
Elbow Orthoses
— Counter-Force Elbow Orthosis uses Gas "Spring" Cylinder (Illust.) 10-28(96-97)
— Functional Elbow Orthosis with Pneumatic Counterbalance, VAPC Research Report 10-25(138-141) 10-26(218-220)
Elbow Prostheses
— VAPC Electric Elbow, VAPC Research Report, 10-23(223-224)
Electrically Driven Artificial Hand for Upper Extremity Prosthesis
— Recent Patents: Yakov Savelievich 10-24(285)
Electrically Driven Hand Orthosis Device for Providing Finger Prehension
— Recent Patents: John P. Ryan, James W. Cowan, Paul K. Sharp, et al. 10-27(208)
Electrically Operated Brake for Powered Wheelchairs
— VAPC Research Report 10-27(106-107)
Electrically Powered Prostheses
— The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients With Myoelectric Control: Hannes Schmidl 10-27(17-42)
Electrically Powered Prostheses *see also* Electric, Electrical, Upper-Limb Prostheses, Myoelectric, etc.
Electrical Stimulation
— Electrical Stimulation: Eugene F. Murphy 10-22(245-246)

— Electrical Stimulation for Bladder Control
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Evaluation of Electrical Stimulation as a Treatment for the Reduction of Spasticity: Ross Davis and John W. Gesink 10-22(302-309)
— Electrical Stimulation of Hard Tissue Growth
— Acceleration of Bone Healing by Electrical Stimulation: George Van B. Cochran 10-22(291-294)
— Acceleration of Bone Healing by Electrical Stimulation. Contractor Reports: G.V.B. Cochran (St. Luke's Hospital, New York, N.Y.) 10-21(141-142) 10-23(315-318) 10-24(238-239) (Helen Hayes Hospital, West Haverstraw, N.Y.) 10-25(208-209) 10-26(322 no report) 10-27(157-158) 10-28(179-180) 10-29(136) 10-30(209)
— Evaluation of Electrical Techniques for Stimulation of Hard Tissue Growth. Contractor Reports: R.O. Becker, J.A. Spadaro, and A.A. Marino (VA Hospital, Syracuse, New York) 10-27(180-184) 10-28(224 no report) 10-29(133-136) 10-30(206-209)
— Electrical Osteogenesis — Basic Studies 10-30(206-208)
— Electrical Osteogenesis — Clinical Studies 10-30(208)
— Electrical Stimulation of Bone Growth 10-29(136)
— Electrically Injected Silver Ions as a Local Bactericidal Agent 10-29(133)
— Fracture Healing 10-30(209)
— Regeneration 10-30(208-209)
— Silver Compounds as Additives to Bone Cement 10-29(134)
— Electrical Stimulation of Limbs: Pierre Rabischong, Francois Bonnel, Etienne Dombre, Edouard Peruchon, Philippe Coiffet, Blaine Fournier, and Jean-Marie Brebic 10-22(261-290)
— Part — I Basic Studies 10-22(261-273)
— Part II — Open Loop Control of Muscular Contraction 10-22(273-289)
— Electrical Stimulation of Limbs: Part III. Joint Position Control: Alain Fournier, Etienne Dombre, and Philippe Coiffet 10-25 (5-24)
— Dynamic Study of a Joint With a Single Degree of Freedom 10-25(6-11)
— Determination of the Biomechanical Parameters 10-25(7-8)
— Determination of the Control Signal and of the Joint Position 10-25(8-9)
— Identification Procedures 10-25(14-17)
— Identification of the Joint 10-25(14-16)

— Model of Muscle Alone 10-25(14)
— Simulation of the Model 10-25(16-17)
Electrical Stimulation of Nerves, Muscles, *see* Functional Electrical Stimulation, Neuromuscular Stimulation, Transcutaneous Nerve Stimulation
Electrical Switch for Use by the Disabled
— Recent Patents: Herbert C. Dickey 10-30(288)
Electric Arm
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Background and Information 10-30(8-9)
Electric Back-Recliner Kit
— VAPC Research Report 10-28(103) 10-29(86-87)
Electric Elbow
— Recent Patents: Carl Mason 10-27(208-209)
Electric Opponens-Type Hand Splint
— VAPC Research Report 10-23(226-228)
Electric Wheelchairs *see* Wheelchairs
Electrocortical Prosthesis
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Experimental Devices 10-30(108-111)
Electrocutaneous Feedback
— Electrocutaneous Feedback for Artificial Limbs. Summary Progress Report. February 1, 1974, through July 31, 1975: Ronald E. Prior and John Lyman 10-24(3-37)
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand. Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case and Charles M. Scott 10-26(170-191)
Electrocutaneous Feedback, Electrotactile Feedback, *see also* Sensory Feedback
Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Lesioning 10-23(97-106)
— Electrolytic Lesions 10-23(99-103)
— Radiofrequency Lesions 10-23(103-106)
— Physical and Chemical Factors Affecting Implanted Electrodes 10-23(52-61)
— Recording Electrodes 10-23(106-143)
— Brain Recording 10-23(106-118)
— Digestive Tract Recordings 10-23(138-142)
— Heart Recording 10-23(118-123))
— Intracardiac Recording 10-23(122-123)
— Muscle Recording 10-23(123-142)

— Long-Term Muscle Recordings (Prosthetic Devices) 10-23 (133-138)
— Recordings from the Spinal Cord 10-23(142-143)
— Temporary Muscle Recordings 10-23(124-133)
— Stimulating Electrodes 10-23(62-96)
— Brain Stimulation 10-23(62-63)
— Diagnostic Electrodes 10-23(63-69)
— Prosthetic Devices 10-23(69-74)
— Dorsal Column Stimulation for the Relief of Pain 10-23(86-89)
— Electrical Stimulation for Bladder Control 10-23(92-96)
— Continence 10-23(96)
— Voiding 10-23(92-96)
— Heart Stimulation 10-23(75-86)
— Muscle Stimulation 10-23(91-92)
— Nerve Stimulation 10-23(89-91)
Electrodes
— Clinical Application of Electrode Implantation in the Human Body. Contractor Reports: M.H. Chase and M. Babb (University of California, Los Angeles, The Center for Health Sciences, Brain Information Service, Los Angeles, California) 10-21(147-148)
— Electrocutaneous Feedback for Artificial Limbs. Summary Progress Report. February 1, 1974, Through July 31, 1975: Ronald E. Prior and John Lyman 10-24(3-37)
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Evaluation of Electrical Techniques for Stimulation of Hard Tissue Growth. Contractor Reports: R.O. Becker, J.A. Spadaro, and A.A. Marino (VA Hospital, Syracuse, New York) 10-27(180-184) 10-28(224 no report) 10-29(133-136) 10-30(206-209)
— Electrical Osteogenesis — Basic Studies 10-30(206-208)
— Electrical Osteogenesis — Clinical Studies 10-30(208)
— Electrical Stimulation of Bone Growth 10-29(136)
— Electrically Injected Silver Ions as a Local Bactericidal Agent 10-29(133)
— Electrochemical Behavior of Various Metals which Could Be Used for Electrical Stimulation of Bone Growth 10-30(206-208)
— Fracture Healing 10-30(209)
— The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients with Myoelectric Control: Hannes Schmidl 10-27(17-42)
— A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals Using Microprocessors: Daniel Graupe et al. 10-27(4-16)
— Explanation of System Requiring Only One, Two, or Three Electrode Sites 10-27(4-5)
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—

A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Socket and Harnessing 10-30(21-23)
— Electrodes and Electrode Support 10-30(23-24)
— Studies Toward a Practical Computer-Aided Arm Prosthesis System: John Lyman, Amos Freedy, and Moshe Solomonow
— Evaluation of Various Electrodes 10-22(217-219)
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand. Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case and Charles M. Scott 10-26(170-191)
— Undesired Interaction between Myoelectric Control and Electrocutaneous Feedback 10-26(173-175)
— Survey of Implanted Electrodes: Michael H. Chase 10-22(259-260)
— VAPC Contract with Rancho Los Amigos Hospital to Furnish Upper-Limb Prosthesis Systems with Sensory Feedback Using Surgically Implanted Electrodes, VAPC Research Report 10-24(208)
— *See also* Functional Electrical Stimulation, Sensory Feedback
Electrode-Tissue Interfaces
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
Electrohydraulic Above-Knee Prosthesis
— A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W.R. Dyck, S. Onyshko, D.A. Hobson, D.A. Winter, and A.O. Quanbury 10-23(169-186)
Electrohydraulic *see also* Hydraulic
Electrolytic Lesions
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Electrolytic Lesions 10-23(99-103)
Electromyographic Feedback
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
— Clinical Research with Cerebral Palsied Children 10-25(28-34)
— Biofeedback (Myofeedback) in Rehabilitation for Hemiplegia
— Contractor Reports: R. Shiavi, S. Champion, and F. Freeman (VA Hospital, Nashville, Tenn.) 10-30(217-223)
Electromyographic Knee Control System
— VAPC Research Report 10-24(157-160)
Electronic Hearing Apparatus
— Recent Patents: Alfred A.A. Tomatis 10-28(257)
Electronic Mobility Devices *see* Electronic Travel Aids
Electronic Power Conversion Kit for Wheelchairs
— VAPC Research Report 10-26(246) 10-28(102)

Electronic Travel Aids (ETA)
— Clinical Study of Mobility Aids for the Blind. Contractor Reports: J.D. Malamazian, L.W. Farmer, and J.J. Whitehead (VA Hospital, Central Rehabilitation Section for Visually Impaired and Blinded Veterans, Hines, Illinois) 10-25(219-221) 10-26(351-352) 10-27(187-190) 10-28(230-231) 10-29(167-169) 10-30(268-270)
— Laser Cane 10-25(219-220) 10-26(352) 10-27(189) 10-29(169)
— Lindsay Russell Pathsounder 10-25(219-220) 10-27(188-189)
— Sonicguide 10-25(219-220) 10-26(352) 10-27(189-190) 10-29 (169) 10-30(268-270)
— Current State of the Research Effort at Veterans Administration, Hines, Illinois: John D. Malamazian and Harvey Lauer
— Electronic Mobility Aids Program 10-22(453-454)
— Electronic Mobility Devices: Loyal E. Apple (Western Blind Rehabilitation Center) 10-22(458-459)
— Bionic Laser Cane 10-22(458-459)
— Binaural Sensory Aid 10-22(459)
— Mobility Aids for the Blind: Howard Freiberger
— Binaural Sensory Aid 10-22(75-76)
— Laser Typhlocane 10-22(75)
— Mims Seeing Aids 10-22(77-78)
— Mowat Sonar Sensor 10-22(77-78)
— Mobility Devices: Leicester W. Farmer
— Conclusion — ETA's 10-30(111-112)
— Electronic Travel Aids (ETA's): History and Development 10-30(75-108)
— Background 10-30(75-77)
— Benefits from ETA's 10-30(78)
— The Binaural Sensory Aids (BSA) 10-30(98-102)
— Candidate Requirements 10-30(80)
— Considerations in Selection 10-30(80-81)
— Definition and Purpose 10-30(77)
— Display of Environmental Information 10-30(81-82)
— Functions Performed by ETA's 10-30(77-78)
— Guidelines for Design 10-30(78-80)
— Laser Canes and Other Aids Using Optical Principles 10-30(87-96)
— Other Electronic Devices and Systems 10-30(102-108)
— A Canterbury Child's Aid 10-30(108)
— The FOA Swedish Laser Cane 10-30(105)
— Light Probes 10-30(102)
— The Mims Infrared Mobility Aid 10-30(105-106)
— Mowat Sonar Sensor 10-30(102-103)
— The Nottingham Obstacle Detector 10-30(104-105)

— The Single Object Sensor (SOS) Bui Device 10-30(106-107)
— The Sonicguide 10-30(97)
— The Torch 10-30(97-98)
— The Lindsay Russell E Model Pathsounder 10-30(82-84)
— The SE Pathsounder 10-30(84-87)
A Preliminary Followup Study of Electronic Travel Aid Users: Nancy C. Darling, Gregory L. Goodrich, and J. Kenneth Wiley. (Western Blind Rehabilitation Center) 10-27(82-91)
Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects
— Contractor Reports: P.P. Griffin, R.G. Shiavi. VA Hospital, Nashville, Tennessee 10-29(144-145) S. Champion, and F. Freedman 10-30(217-223)
— Ascending and Descending Stairs: A Pilot Study 10-29(144)
— Biofeedback (Myofeedback) in Rehabilitation for Hemiplegia 10-30(217-224)
— Biomechanics of Normal Human Locomotion 10-29(144)
Electrostimulation
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Prosthetic Devices 10-23(69-74)
— *See also* Electrical Stimulation, Functional Electrical Stimulation, Stimulation of Growth of Bone and Soft Tissue
Electrotactile Sensory Aids *see* Neurophysiological Studies (Contractor Reports: University of California, Los Angeles, California)
Elektroftalm
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Experimental Devices 10-30(108-111)
— Background 10-30(75-77)
Elkins, Earleen
— Development of Improved Techniques for the Analysis of Hearing-Aid Performance. Contractor Reports: G.D. Causey, E. Elkins, and Lucille Beck (BioCommunications Lab., University of Maryland, College Park, Md.) 10-23(342-346) 10-24(269 no report) 10-25(231-233) 10-26(357-360) 10-27(191-196) 10-28(235-238) J.L. Punch, and H.C. Schweitzer (VAH, Washington, D.C.) 10-29(179-185) 10-30(276-278)
— Influence of Input and Gain Values Upon Electroacoustic Properties of Hearing Aids. Contractor Reports: G.D. Causey, E. Elkins, and L.B. Beck (BioCommunications Laboratory, University of Maryland, College Park, Md.) 10-21(166-170)
EMG Control
— A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W.R. Dyck, S. Onyshko, D.A. Hobson, D.A. Winter, and

A.O. Quanbury 10-23(169-186)
— Design of EMG Control Electronics 10-23(178-182)
— Control of Upper-Limb Prostheses in Several Degrees of Freedom: Daniel Graupe
— EMG-Actuated Subsystem 10-22(228-231)
— Introduction 10-22(226)
— Status of the Johns Hopkins Research Program on Upper-Limb Prosthesis-Orthosis Power and Control System: Woodrow Seamone and Gerhard Schmeisser, Jr.
— Control Input Sensor Development 10-22(242-244)
— Powered Orthoses 10-22(241-242)
— Low Force Level Shoulder Control 10-22(239-240)
— Single Site EMG Sensor 10-22(238)
— Studies Toward a Practical Computer-Aided Arm Prosthesis System: John Lyman, Amos Freedy, and Moshe Solomonow
— EMG-Pattern Control Technique 10-22(221-222)
— Toward Clinical Application 10-22(224-225)
End Point Control of Upper Extremity Orthotic Brace Using Head Orientation
— Recent Patents: Jon H. Friedman 10-21(178)
Engineering Applications in Orthotic and Prosthetic Treatment of Musculoskeletal Defects
— Contractor Reports: E. Byron Marsolais, A.H. Burstein, Eduard Schulz. VA Hospital, Wade Park, Cleveland, Ohio 10-26(341-344) 10-27(172-174) 10-28(195-214) 10-29(127-129) 10-30(201)
Engineering Design Criteria
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Design of Engineering Model 10-30(19-20)
Engineering Students Test Voice-Controlled System for Quadriplegics
— Notes and News 10-25(247)
Engineers' Joint Council
— International Engineering Bicentennial Conference. Calendar of Events 10-24(292)
English Language Edition of Book on the EEG's of Blind Persons Published
— Notes and News 10-22(527)
Environmental Control and Communication Systems
— Adapted VAPC Hospital Environmental Control System for Home Use 10-28(100)
— AMBRDL Random Access Environmental Control, VAPC Research Report 10-25(140-142)
— Comfortcom (Bunting Stereo Systems), VAPC Research Report

10-23(241-242)
— Control and Communication Devices for the Severely Disabled: Ronald Arroyo 10-25(55-68)
— Portaprint 10-25(63-65)
— Possum Typewriter 10-25(66)
— Scope Voice-Operated Typewriter and Environmental Control 10-25(60-62)
— Strip Printer 10-25(65)
— Tufts Interactive Communicator 10-25(65)
— VAPC Communicator 10-25(63)
— VAPC Home Model Environmental Control System 10-25(58-59)
— VAPC Hospital Model Environmental Control System 10-25(55-58)
— VAPC Remote Station Environmental Control 10-25(59)
— The Current Status of and Future Considerations for Environmental Control Systems: Robert Green 10-22(310-325)
— Fidelity Comfort and Communication Control System 10-26(220) 10-27(97)
— Fidelity Comfort and Communication System (FCCS) Security Sentinel 10-26(222-223) 10-27(97) 10-30(122-123)
— Genie Environmental Control, VAPC Research Report 10-24(166-168)
— Lifeline Home Emergency Alarm System 10-27(101)
— Manual Communications Module 10-27(98)
— Mechanically Operated Voice Synthesizer (MOVS) 10-27(100-101)
— Microlert System 10-27(105)
— Microlert System for the Home 10-30(125)
— NUCCS (Northwestern Univ. Comfort and Communication System 10-23(242-243)
— Nu-Life Environmental Control System 10-24 (168-171)
— Paratrol Mk. II, Prentke Romich Co. 10-25(142-143)
— Portable Telephones 10-27(98-100)
— PortaPrinter, VAPC Research Report 10-25(144-145)
— POSSUM Environmental Control 10-24(171-173)
— Prentke Romich ECU 1 10-27(95-96)
— ROBOT System (Remote Operation by Oral Triggering) 10-26(220-221)
— Touch-Operated Selector Control (TOSC) 10-26(220-222) 10-27(96-97)
— Tufts Interactive Communicator (TIC) 10-23(248-249)
— VAPC Communicator 10-23(245-250)
— VAPC Home Environmental Control System 10-23(243-245)
— VAPC Hospital Environmental Control 10-26(222)

— VA Prosthetics Center Research, Development, and Evaluation Program: Edward Peizer
— Communication Devices 10-22(475-476)
— Home Environmental Control Systems 10-22(474-475)
— Hospital Environmental Control Systems 10-22(474)
— Reading Machines 10-22(476)
— Scope System 10-22(475)
— Telemetry for Environmental Controls 10-22(475)
— Voice Actuation of Environmental Controls 10-22(475)
— VAPC Remote Station Environmental Control 10-24(162-166)
— VAPC Wireless Environmental Control 10-23(245-246)
— VOTECS (Scope Electronics) VAPC Research Report 10-23(246-248)
— VOTRAX Handi-Voice System VAPC Research Report 10-28(101-102)
— Zero-Pressure Remote Power Control VAPC Research Report 10-26(223)
— Zero Pressure Telephone Dialer, VAPC Research Report 10-27(104)
Environmental Communication and Control Systems *see also* VAPC Research Reports — Spinal Cord Injury Rehabilitation — Environmental Control Systems
Erie City Manufacturing Co., Erie, Pennsylvania
— Arrow Wheelchair VAPC Research Report 10-29(90, Illust. 93)
Eroyan, Gary
— Artificial Hand and Forearm. Recent Patents 10-30(287)
ETA's (Electronic Travel Aids)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Electronic Travel Aids (ETA's): History and Development 10-30(75-108)
— Background 10-30(75-77)
ETA Training Courses
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Binaural Sensory Aids (BSA) 10-30(98-102)
ETA's *see also* Electronic Travel Aids, Mobility Aids
European Conference on Disability in the Family, and Naidex '78 Exhibition of Aids for the Disabled
— Calendar of Events 10-28(264-265)
Evaluation of Aids for the Elderly
— VAPC Research Report 10-24(203-204)
Evaluation of Electrical Stimulation as a Treatment for the Reduction of Spasticity: Ross Davis and John W. Gesink 10-22(302-309)
Evaluation of Electrical Techniques for Stimulation of Hard Tissue Growth
— Contractor Reports: R.O. Becker, J.A. Spadaro, and A.A.

Marino. VA Hospital, Syracuse, New York 10-27(180-184) 10-28(224 no report) 10-29(133-136) 10-30(206-209)
Evaluation Role of VAPC Clinic Team
— VAPC Research Report 10-24(206)
Everest and Jennings Co., Inc., Los Angeles, California
— Hub-Brake Wheel-Lock System 10-27(110-111)
— Mark 20 Power Cart 10-22(47-48)
— Postura Adjustable Support System for Wheelchairs 10-26(244-246)
— Premier Model Wheelchairs, Compliance Testing 10-30(174)
— Rehabilitation Shower/Commode Wheelchair 10-27(111)
— "32" Power Drive, VAPC Research Report 10-24(177-180)
— Trends in Nonlicensed Mobility Aids: Ronald Lipskin 10-22(41-52)
Everett, Bruce E.
— The Reading of Printed Materials by the Blind (Evaluation of an Ink Print Reading Aid: The Stereotoner). Contractor Reports: R.A. Weisgerber, B.E. Everett, and C.A. Smith (American Institutes for Research (AIR), Palo Alto, California) 10-25(233, 236-238)
Everett, Donald B.
— Noise Compensation Techniques for Bioelectric Potential Sensing. Recent Patents 10-26(376)
Exerciser
— Gyro-Gym Therapeutic Exerciser 10-26(262-263)
Exer-Shoe
— VAPC Research Report 10-21(107)
Experience with Closed Circuit Television in the Blind Rehabilitation Program of the Veterans Administration: Edwin B. Mehr, Alan B. Frost, and Loyal E. Apple 10-21(54-68)
Experimental Devices 10-30(108-111)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Electrocortical Prosthesis 10-30(108-109)
— Elektroftalm 10-30(109)
— The Tactile Vision Substitution System 10-30(109-111)
Extension *see* Skeletal Extension
Externally Powered Orthoses
— A Five-Year Review of Clinical Experience with Johns Hopkins University Externally Powered Upper-Limb Prostheses and Orthoses: Gerhard Schmeisser, Jr., and Woodrow Seamone 10-23(211-217)
— Powered Orthosis Development Contractor Reports: Woodrow Seamone and Gerhard Schmeisser, Jr. (Johns Hopkins University) 10-21(132-134) 10-25(202)
Externally Powered Prostheses and Orthoses

— A Five-Year Review of Clinical Experience with Johns Hopkins University Externally Powered Upper-Limb Prostheses and Orthoses: Gerhard Schmeisser, Jr., and Woodrow Seamone 10-23(211-217)
— Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prostheses and Orthoses. Contractor Reports: W. Seamone and G. Schmeisser, Jr. (Johns Hopkins University)
— Continued Evaluation of Externally Powered Upper-Limb Prostheses 10-27(148-149)
— Followup of Field Evaluation of Externally Powered Upper-Limb Prosthesis 10-26(316)
— Powered Prosthesis Development 10-25(202-203)
— Short Above-Elbow Prosthesis 10-21(130-132)
— Shoulder-Disarticulation Prosthesis 10-21(129-130)
— The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients with Myoelectric Control: Hannes Schmidl 10-27(17-42)
— Pneumatic vs. Electric Prosthesis Power 10-27(17-20)
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Background and Information 10-30(8-9)
— Status of the Johns Hopkins Research Program on Upper-Limb Prosthesis-Orthosis Power and Control System: Woodrow Seamone and Gerhard Schmeisser, Jr. 10-22(237-244)
Externally Powered Prostheses and Orthoses *see also* Control Systems, Orthotics, Prosthetics, etc.
Eyeglass Mounted Mobility Aid
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Display of Environmental Information 10-30(81-82)
E-Z Patient Turning System
— VAPC Research Report 10-28(118-119) 10-29(95-98)
E-Z Reacher #201
— VAPC Research Report 10-23(250-251)
E-Z Tilt-a-Board Loader
— VAPC Research Report 10-28(122-123)
EZ-1 Wheelchair Carrier
— VAPC Research Report 10-28(123-124)

F

FAA (Federal Aviation Administration) Proposed Air Travel Regulations Opposed by Easter Seal Society

— Notes and News 10-22(525)
Fabrication of Obstacle Detectors for the Blind
— Contractor Reports: T.A. Benham, J.M. Benjamin, Jr., and D.R. Bolgiano. Bionic Instruments, Inc., Bala Cynwyd, Pa. 10-21(151-153)
— Documentation 10-21(152)
— Outreach 10-21(152-153)
— Performance Testing 10-21(152)
— Public Exposure 10-21(151-152)
— Repair of C-4 Canes 10-21(151)
Facial Prosthetics
— The First International Symposium On Facial Prosthetics, Arnhem, The Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
Falcon Research and Development, Denver, Colorado
— Independence Powered Recliner Kits for E&J Fully Reclining Wheelchairs 10-30(131-133)
— Independence Wheelchair, VAPC Research Report 10-23(237-238)
Falkenberg, Eric
— Spinal-Cord-Injury Studies: Paralysis, Spasticity, and Pain. Contractor Reports: J.W. Gesink, M. Rosen, E. Falkenberg, and J.D. Jacobi (VA Hospital, Miami, Florida) 10-23(328-329) 10-24(250)
Farmer, Leicester W.
— Clinical Study of Mobility Aids for the Blind. Contractor Reports: J.D. Malamazian, L.W. Farmer, and J.J. Whitehead (VA Hospital, Hines, Ill.) 10-25(219-221) 10-26(350-352) 10-27(187-190) 10-28(230-232) 10-29(167-169) 10-30(268-270)
— Mobility Devices: L.W. Farmer 10-30(47-118)
— Reading and Mobility Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports: J.D. Malamazian, L.W. Farmer, and J.J. Whitehead (VAH, Hines, Ill.) 10-21(160-161)
Federal Aviation Administration
— FAA Proposed Air Travel Regulations Opposed by Easter Seal Society. Notes and News 10-22(525)
Federal Register
— Federal Register Document 75-8519 (1975) Design Standards and Test Criteria for Automotive Driving Aids, origin of document described 10-23(251-253)
— Federal Register Vol. 40, No. 65, Thurs. April 3, 1975: VA Standard Design and Test Criteria for Safety and Quality of Special Automotive Driving Aids (Adaptive Equipment) for Standard Passenger Automobiles (VAPC-A-7505-8) VAPC Research Report 10-25(162-167)

— Vol. 43, No. 96, Wed., May 17, 1978: Pages 21390-21402. The VA Standard Design and Test Criteria for Safety and Quality of Automatic Wheelchair Lift Systems for Passenger Motor Vehicles 10-30(148-173)
Federal Screw Works, Vocal Interface Div., Troy, Michigan
— VOTRAX Handi-Voice System, VAPC Research Report 10-28(101-102)
Federal Woman's Award for Mary Patricia Murray, Ph.D.
— Notes and News 10-26(368-369)
Feeders
— Morewood Spoon Lifter *see* Winsford Feeder
— Sydnor Feeder 10-26(261-262)
— Winsford Feeder (Illust.) 10-28(126-128)
Feet
— Physical Response for SACH Feet Under Laboratory Testing: R.L. Daher 10-23(4-50)
— *See also* SACH Feet, Lower-Limb Prostheses
Feldstein, Cyril
— Subminiature Insertable Force Transducer. Recent Patents 10-26(376)
Ferguson, Andrew Marvin
— Shock Absorber Attachment for Wheelchairs or the Like. Recent Patents 10-30(291)
Fidelity Electronics Ltd., Chicago, Illinois
— Fidelity Comfort and Communication Control System (FCCS), VAPC Research Report 10-23(242-243) 10-26(220) 10-27(97)
— Fidelity Comfort and Communication System (FCCS) Security Sentinel, VAPC Research Report 10-26(222-223) 10-27(97-98) 10-30(122-123)
— NUCCS (Northwestern Univ. Comfort and Communication System) 10-23(242-243)
Finley, F. Ray
— Pattern-Recognition Arm Prosthesis— A Final Report: R. Wirta, D.R. Taylor, and F.R. Finley 10-30(8-35)
First Aid
— An Occipito-Zygomatic Cervical Orthosis Designed for Emergency Use — A Preliminary Report 10-29(50-64)
First Formal University-Sponsored Course in Prosthetics Took Place in Spain
— Notes and News 10-21(175)
The First International Symposium on Facial Prosthetics. Arnhem, The Netherlands. April 19-23, 1976: John F. Lontz 10-25(129-133)
The First National Conference on Aging and Blindness
— Notes and News 10-23(354)
Fishman, Sidney

— Appointed Professor by NYU School of Medicine. Notes and News 10-25(247-248)
Fitting Procedures
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
— Fitting Procedures 10-24(73-75)
Fitting Procedures, Lower Limb
— Development of Refined Fitting Procedures for Lower-Limb Prostheses: Augusto Sarmiento 10-22(114-132)
Fitting Procedures, Prosthetic
— Development of Refined Fitting Procedures for Lower-Limb Prosthesis—Case Studies of Applied Research in Orthotics and Prosthetics. Contractor Reports: A. Sarmiento, N.C. McCollough III, W.F. Sinclair (University of Miami School of Medicine, Miami, Florida) 10-21(136-137) 10-23(310-311) L. Latta 10-24(234-235) 10-25(204) 10-26(317) F.R. Hampton 10-28(162-178, A Final Report)
— A Five-Year Review of Clinical Experience with Johns Hopkins University Externally Powered Upper-Limb Prostheses and Orthoses: Gerhard Schmeisser, Jr., and Woodrow Seamone 10-23(211-217)
— Selection and Evaluation Process 10-23(214)
— Summary of Clinical Determinants Utilized in the Prescriptions of Appropriate JHU Sensor and Power Unit 10-23(216-217)
Flam, Eric
— Support Means for the Even Distribution of Body Pressure. Recent Patents 10-23(360)
Flammability and Toxic Fume Tests
— VAPC Research Report 10-24(200)
"Flashlight" Detector
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The G-5 Obstacle Detector 10-30(89)
Flatau, Carl R.
— Articulated Master Slave Manipulator. Recent Patents 10-27(208)
Fletcher, James C.
— Subminiature Insertable Force Transducer. Recent Patents 10-26(376)
Flora, John H.
— Method and System for Control of a Powered Prosthetic Device. Recent Patents 10-26(376)
Flow Patterns in Visually Guided Travel
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)

— Flow Patterns 10-26(72)
Fluid-Filled Cushioning Assemblies
— Recent Patents: J. Herbert Keeton 10-29(195)
Fluidics Techniques Application
— A Device Designed to Approximate Shear Forces on Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
Fluted Hip Nail Implant System for Orthopaedic Surgery
— Recent Patents: Albert H. Burstein, and Kingsbury G. Heiple 10-28(257)
The FOA Swedish Laser Cane
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Other Electronic Devices and Systems 10-30(102-108)
Folding or Collapsible Canes
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Folding or Collapsible Canes 10-30(50-54)
Folding Walkers
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Walkers 10-30(70-75)
Foot Control for Electrically Powered Wheelchairs
— VAPC Research Report 10-21(88-99)
"Force-Impact and Echo-Ranging Data" from the Long Cane
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Advantages 10-30(49-50)
Forearm and Forearm Trough Crutches
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Support or Orthopedic Canes and Crutches 10-30(56-70)
Foster, John A.
— Functional Neuromuscular Stimulation of Limbs: A Feasibility Study. Contractor Reports: J.A. Foster and M. Solomonow (VA Hospital, Los Angeles, California) 10-30(203-205)
Foulds, Richard A.
— Tufts Interactive Communicator, VAPC Research Report 10-23(249)
Four More Overseas Prosthetic-Orthotic Workshops Planned by World Rehabilitation Fund
— Notes and News 10-27(205-206)
Fournier, Alain
— Electrical Stimulation of Limbs: Part I Basic Studies, Part II — Open Loop Control of Muscular Contraction: P. Rabischong, F. Bonnel, E. Dombre, E. Peruchon, P. Coiffet, A. Fournier, and J. Brebic 10-22(261-290)
— Electrical Stimulation of Limbs—Part III. Joint Position Control: A. Fournier, E. Dombre, and P. Coiffet 10-25(5-24)
Fowler, John H.

— Lift Device. Recent Patents 10-21(178)
Frankel, Victor H.
— In Vivo Loading of Knee Joint Replacement: A.H. Burstein, V.H. Frankel, and E.B. Marsolais 10-22(193-199)
— In Vivo Loading of Knee Joint Replacement. Contractor Reports: A.H. Burstein, and V.H. Frankel (Case Western Reserve Univ., Cleveland, Ohio) 10-24(253-254) 10-25(214)
The Franklin Institute
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Background 10-30(75-77)
Fredrickson, John M.
— Implantable Electromagnetic Hearing Aid. Recent Patents 10-23(358)
Freedy, Amos
— Fundamental and Applied Research Related to the Design and Development of Upper-Extremity Externally Powered Prostheses. Contractor Reports: J.H. Lyman, A. Freedy, and R. Prior (University of California, Los Angeles, Calif.) 10-21(122-123) 10-23(284-285) 10-24(219-220) 10-25(184-194) 10-26(286-288) M. Solomonow 10-27(129-132) 10-28(139-141) 10-29(104-106) 10-30(179-181)
— Studies Toward a Practical Computer-Aided Arm Prosthesis System: J. Lyman, A. Freedy, and M. Solomonow 10-22(213-225)
Freeman, Frank
— Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects. Contractor Reports: P.P. Griffin, R. Shiavi, S. Champion, and F. Freeman (VA Hospital, Nashville, Tennessee) 10-30(217-223)
Freewheeler Electric Wheelchair
— VAPC Research Report 10-26(228-229)
Freiberger, Howard
— Editorial—". . . And Sensory Aids II": H. Freiberger 10-26(1-8)
— Editor of Sensory Aids: Highlights of Other VA Research Programs 10-21(150-173) 10-23(330-352) 10-24(256-275) 10-25(215-242) 10-26(344-364) 10-27(185-200) 10-28(225-242) 10-29(164-186) 10-30(261-279)
— Mobility Aids for the Blind: H. Freiberger 10-22(73-78)
— Sensory Aids: H. Freiberger, Moderator 10-22(417-419)
French-Italian Marketing Corp., Great Neck, New York
— Importer, LEM Power Chair (Italian) 10-28(114-115) 10-30(126-127)
Frenzel, William K.
— Prosthetic Device for Holding Golf Clubs. Recent Patents 10-27(209-210)
Freon-12

— A Device Designed to Approximate Shear Forces On Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— Flapper Valve Design (Fluidics) 10-30(39-42)
Freter, John M.
— Ankle Block. Recent Patents 10-26(375)
— Knee Prosthesis. Recent Patents 10-25(257)
Friedenberg, Zachary B.
— Constant Current Power Pack for Bone Healing and Method of Use. Recent Patents 10-23(358)
Friedman, Jon H.
— End Point Control of Upper Extremity Orthotic Brace Using Head Orientation. Recent Patents 10-21(178)
Frileck, Stanley P.
— Controlled Early Ambulation of Heel Surface Defects Covered by Pedicle Flaps in Lower-Limb Amputees: J.H. Herndon, A.M. Lanoue, and S.P. Frileck 10-21(9-22)
Frost, Alan B.
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, and A. Wood (Western Blind Rehab. Center, VA Hospital, Palo Alto, Calif.) 10-23(339-341)
— Experience with Closed Circuit Television in the Blind Rehabilitation Program of the Veterans Administration: E.B. Mehr, A.B. Frost, and L.E. Apple 10-21(54-68)
Functional Ankle for a Prosthetic Limb
— Recent Patents: Charles C. Asbelle, Gene R. Helmuth, William R. Applegate, and Gerald K. Porter 10-29(195)
Functional Elbow Orthosis
— VAPC Research Report 10-25(138-140) 10-26(218-220)
— *See also* Elbow
Functional Electrical Stimulation
— Engineering Applications in Orthotic and Prosthetic Treatment of Musculo-Skeletal Defects. Contractor Reports: E.B. Marsolais, A.H. Burstein, E. Schulz (VA Hospital, Wade Park, Cleveland, Ohio) 10-26(341-344) 10-27(172-174) 10-28(195-214) 10-29(127-129) 10-30(201)
— Comparison of Implanted Electrical Stimulation (Neuromuscular Assist) to other Methods of Treating the Equinovarus Foot 10-27(173) 10-28(204-209) 10-29(128)
— Functional Electrical Stimulation of the Muscles of the Hip 10-26(343-344) 10-27(173-174) 10-28(209-210) 10-29(128-129)
— Liberson Electrical Stimulation System, 10-27(115-116)

— Patient Evaluation of a Functional Electrical Stimulation Hand Orthosis. Contractor Reports: P.H. Peckham (VA Hospital, Wade Park, Cleveland, Ohio) 10-26(344) 10-27(174-176) 10-28(214-218) 10-29(130-132) 10-30(201-203)
Functional Neuromuscular Stimulation of Limbs: A Feasibility Study
— Contractor Reports: J.M. Foster and M. Solomonow. VA Hospital, Los Angeles, California 10-30(203-205)
— Background 10-30(203-204)
— Methods 10-30(204)
— Results 10-30(205)
Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses
— Contractor Reports: J.H. Lyman, A. Freedy, and R. Prior. University of California, Los Angeles, School of Engineering and Applied Science. Biotechnology Laboratory, Los Angeles, California 10-21(122-123) 10-23(284-285) 10-24(219-220) 10-25(184-194) 10-26(286-288) Moshe Solomonow 10-27(129-132) 10-28(139-141) 10-29(104-106) 10-30(179-181)
Funding and Actual Expenditures for VA Research and Development
— Twenty-Five Years of Progress: Monroe J. Gershenson and Wilfred G. Holsberg 10-21(3-8)

G

Gadbaw, Patricia D.
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: G. Gillispie, W. De l'Aune, P. Gadbaw, and C. Lewis (Eastern Blind Rehab. Center, VA Hospital, West Haven, Conn.) 10-21(170-173) 10-23(348-351) 10-24(271-274) 10-25(238-241) D. Garner 10-26(360-363) 10-27(196-198) 10-28(238-240) 10-29(164-167) 10-30(261-268)
Gager, Dennis J.
— Inflatable Sole Shoe. Recent Patents 10-28(257)
Gait
— A Kneeless Leg Prosthesis for the Elderly Amputee, Advanced Version: Rahamin Seliktar and R.M. Kenedi 10-25(97-119)
— Dynamic Analysis of Gait 10-25(115-119)
Gait Analysis
— Biomechanical Studies of Human Locomotion. Contractor Reports: Charles W. Radcliffe, Don M. Cunningham, James M. Morris, and Larry Lamoreux (University of California, Berkeley, Calif.)

— Angle Diagrams 10-23(288-289)
— Angle Motions During Walking 10-25(196-197)
— Clinical Gait-Assessment Project 10-30(195)
— Clinical Instrumentation 10-23(288)
— Computer Generation of Gait Kinematics 10-26(295)
— Effect of the UC-BL Shank Axial-Rotation Unit on Selected Gait Variables 10-23(289)
— Energy Level and Power of Body Segments 10-26(295-299)
— Energy Optimization in Gait 10-26(295)
— Foot-Ankle Goniometer 10-23(288)
— Gait Dynamics 10-26(295) 10-27(134)
— Instrumentation for Clinical Gait Evaluation 10-25(197) 10-27(135-137)
— Kinematic Prediction of Joint Loads and Power 10-26(299-301)
— Laboratory Instrumentation 10-23(286)
— Structure and Function in the Ankle 10-23(286-288)
— Time and Distance Measurements 10-23(288)
— Unequal Leg Length and Low-Back Pain 10-25(197) 10-27(134-135)
— Biomechanical Studies of Human Locomotion: Charles W. Radcliffe 10-22(168-183)
— Cyclic Event Markers 10-22(170-172)
— Data-Control Information 10-22(178-180)
— Forces and Moments in the Lower Limb 10-22(172-173)
— Gait Evaluation 10-22(181-183)
— Instrumented Walkway 10-22(168-170)
— Self-Aligning Goniometry 10-22(173-177)
— Clinical Gait Analyzer: Jacquelin Perry 10-22(188-192)
— Clinical Gait Analyzer. Contractor Reports: J. Perry (The Professional Staff Association of the Rancho Los Amigos Hospital, Downey, California) 10-21(149-150) 10-23(329 no report) 10-24(251-253) 10-25(214)
— Hardware Design 10-24(251)
— Method of Procedure 10-21(149-150)
— Normal Rate 10-24(251)
— Prototype Fabrication 10-24(251)
— Purpose 10-21(149)
— System Test 10-24(251-253)
— *See also* VA-Rancho Gait Analyzer
— Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects. Contractor Reports: P.P. Griffin, R.G. Shiavi (VA Hospital, Nashville, Tennessee) 10-29(144-145) S. Champion, and F. Freedman 10-30(217-223)
— Ascending and Descending Stairs: A Pilot Study 10-29(144)

— Biomechanics of Normal Human Locomotion 10-29(144)
— Engineering Applications in Orthotic and Prosthetic Treatment of Musculoskeletal Defects. Contractor Reports: E.B. Marsolais, A.H. Burstein, E. Schulz (VA Hospital, Wade Park, Cleveland, Ohio) 10-26(341-344) 10-27(172-174) 10-28(195-214) 10-29(127-129) 10-30(201)
— Computer Control for Stroboscopic System 10-26(341-342)
— Three-Dimensional Automated Motion and Joint Force Analysis 10-28(195-204) 10-29(129)
— Three-Dimensional Gait Analysis 10-27(172-173)
— Studies of Normal and Abnormal Motion. Contractor Reports: Mary Patricia Murray (VA Hospital, Wood, Wisconsin) 10-29(139-143) 10-30(216-217)
— Function of the Triceps Surae During Gait 10-30(216-217)
— Gait Patterns of the Parkinsonian Patient 10-29(143)
— Kinesiological Measurements of Functional Performance Before and After Geometric Total Knee Replacement (3) 10-29(141-142)
— Maximum Isometric Knee Flexor and Extensor Muscle Contractions 10-29(142-143)
— Roentgenographic Measurements after Müller Total Hip Replacements 10-29(141)
— Total Hip Joint Replacement Study 10-29(140-141)
— Walking Patterns of Men With Parkinsonism 10-30(216)
— VA-Rancho Gait Analyzer. Contractor Reports: Jacquelin Perry (The Professional Staff Association of the Rancho Los Amigos Hospital, Downey, California) 10-26(331-333)
Gait Pattern
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
— Clinical Research with Cerebral Palsied Children 10-25(28-34)
Gait Training
— Clinical Evaluation of a Sensory Feedback Device: The Limb Load Monitor: Gunilla Wannstedt and Rebecca Craik 10-29(8-49)
Gaitenby, Jane H.
— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: F.S. Cooper, J.H. Gaitenby, I.G. Mattingly, P.W. Nye, and G.N. Sholes (Haskins Laboratories, Inc., New Haven, Conn.) 10-21(153-158) A.M. Liberman 10-23(331-335) 10-24(256-261) 10-25(216-218) F. Ingemann, and L. Shockey 10-26(344-348) 10-27(185-187) 10-28(225-228)
Gallagher, Evan P.
— Prosthetic Guitar Pick. Recent Patents 10-27(210)
Gallium Arsenide Light-Emitting Diodes and Lasers

— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The "Flashlight" Detector 10-30(89)
— Laser Canes 10-30(90-95)
— Laser Hazard 10-30(95)
Galvani, Luigi
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
— Introduction 10-25(38)
Gardner, Harris L.
— Knee Brace. Recent Patents 10-22(528)
Gardner, Henry F.
— Prosthetics: H.F. Gardner 10-22(22-25)
Garner, Donald E.
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: D.E. Garner, W. De l'Aune, and P. Gadbaw (Eastern Blind Rehab. Center, VA Hospital, West Haven, Conn.) 10-26(360-363) 10-27(196-198) 10-28(238-240) 10-29(164-167) 10-30(261-268)
Garwood, Donald C.
— Photocurable Contour Conforming Splint. Recent Patents 10-29(195-196)
Gar Wood Enterprises
— Motorized Wheels, VAPC Research Report 10-21 (94-97)
Gasoline-Fueled Mobility Aids
— VAPC Research Report 10-23(230-235)
Gas-Powered Prostheses
— The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients with Myoelectric Control. Hannes Schmidl 10-27(17-42)
— Limitations of Gas (CO_2) Prosthesis Power 10-27(17-20)
— Pneumatic vs. Electric Prosthesis Power; Some Technical Specifications Compared (Table) 10-27(20)
Gate Control Theory
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
— Theories on the Transmission of Pain 10-25(41-42)
Gaymar High Density Fluid (HDF) Support System
— VAPC Research Report 10-21(103-104) 10-26(251)
Gaymar Industries, Inc., Buffalo, N.Y.
— Gaymar High Density Fluidized (HDF) Bed 10-21(103-104) 10-26(251)
Geisler, Chris Daniel
— Auto-Monitoring Communication Devices for Handicapped Persons. Recent Patents 10-24(284)
Gelbenegger, Franz

— Angle Adjustment Unit for Prostheses and Orthoses. Recent Patents 10-22(528)
Gel Liner Effects
— Transferring Load to Flesh—Part VII. Gel Liner Effects: Leon Bennett 10-21(23-53)
General Interest
— Publications of Interest 10-21(183-185) 10-22(534-536) 10-23(363-364) 10-24(289-291) 10-25(262-264) 10-26(380-383) 10-27(213-215) 10-28(261-263) 10-29(199-200) 10-30(290-298)
General Teleoperators, Inc., Downey, Calif.
— Chin Control Powered Swing Away for Wheelchairs (Illust.) 10-28(103-105)
— Electric Back-Recliner Kit 10-28(103-104)
— GenTel Motor-in-the-Hub Powered Wheelchair (Illust.)10-28(108-109)
— The Remote Outlet 10-28(99)
General Teleoperators, Inc., Paramount, California
— Microfiche Reader, 10-25(143-144)
GENIE Environmental Control
— VAPC Research Report 10-24(166-168)
GenTel Motor-in-the-Hub Powered Wheelchair
— VAPC Research Report 10-28(109)
George Washington University, Washington, D.C.
— External Cosmetic Prosthetic Skin Foam Covers for Multiplex System Prostheses. VAPC Research Report 10-26(217) 10-28(93-94)
— VAPC Contractor to Develop A Sprayable Latex Coating for Artificial Limbs 10-24(207)
Geriatrics
— Southwest Research Institute, San Antonio, Texas, VAPC Contractor to Develop Electromechanical Geriatric Monitor, VAPC Contractual Developmental Program 10-24(206-208)
— University of Southern California, VAPC Contract to Develop Electronic Geriatric Monitor, VAPC Contractual Development Program 10-24(206-208)
— Whittaker Corp., Connecticut, VAPC Contractor to Develop Sonic Physiological Monitor, VAPC Contractual Development Program 10-24(206-208)
Gershenson, Monroe J.
— Twenty-Five Years of Progress: Monroe J. Gershenson and Wilfred G. Holsberg 10-21(3-8)
Gesink, John W.
— Evaluation of Electrical Stimulation as a Treatment for the Reduction of Spasticity: R. Davis and J.W. Gesink 10-22(302-309)

— Spinal-Cord Injury Studies: Paralysis, Spasticity, and Pain. Contractor Reports: J.W. Gesink, M. Rosen, E. Falkenberg, and J.D. Jacobi (VA Hospital, Miami, Fla.) 10-23(328-329)
The G-5 Obstacle Detector
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Laser Canes and Other Aids Using Optical Principles 10-30(87-96)
Gillispie, George M.
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: G.M. Gillispie, W. De l'Aune, P. Gadbaw, and C. Lewis (Eastern Blind Rehab. Center, VA Hospital, West Haven, Conn.) 10-21(170-173) 10-23(348-351) 10-24(271-274)
— Heads VA Blind Rehabilitation. Notes and News 10-25(243)
— Research at the Eastern Blind Rehabilitation Center: G.M. Gillispie and W. De l'Aune 10-22(463-468)
Gingras, G.
— New Head Control for Quadriplegic Patients: Y. Lozac'h, G. Gossalin, E.D. Sherman, G. Gingras and M. Richuk 10-23(151-157)
Gitane Corp., Hawthorne, Calif.
— Distributor, Handicar TVE, French Wheelchair-Carrying Battery-Powered Vehicle 10-30(143-144)
Glabiszewski, Richard
— Articulate Joint for Prosthetic Devices. Recent Patents 10-26(375)
— Prosthetic Appliance. Recent Patents 10-30(290)
Glancy, John
— Developer, Lightweight Transverse Rotator for Lower-Limb Orthoses 10-28(96)
Glaucoma
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Candidate Requirements 10-30(80)
Glowing Cane for the Blind Traveler
— Notes and News 10-28(246-247)
Glucose Analyzer
— Data Collected for Evaluation of Snipas Glucose Analyzer. Notes and News 10-27(207)
— Evaluation of Snipas Glucose Analyzer. Contractor Reports: D.E. Garner, W.R. De l'Aune, and P. Gadbaw (VA Hospital, Eastern Blind Rehabilitation Center, West Haven, Connecticut) 10-27(197-198)
— Snipas Glucose Analyzer Tested. Contractor Reports: J.D. Malamazian and L.W. Farmer (VA Hospital, Central Rehabilitation Section for Visually Impaired and Blinded Veterans, Hines, Illinois) 10-28(231-232)

Godfrey Engineering Ltd., Hanworth, England
— Godfrey Standing Aid, VAPC Research Report 10-24(187-188) 10-26(246-249)
Goldberg, Victor M.
— In Vivo Loading of Knee Joint Replacement. Contractor Reports: R.H. Brown, K.G. Heiple, and V.M. Goldberg (Case Western Reserve University, Cleveland, Ohio) 10-27(168 no report) 10-28(193-194) 10-29(137) 10-30(209-215)
Golf-Cart-Type Mobility Aids
— Chair-E-Yacht Gasoline-Fueled Mobility Aid, VAPC Research Report 10-23(230-232)
— Everest and Jennings Mark 20 Power Cart, VAPC Research Report 10-22(47-48)
— Super Voyager II, VAPC Research Report 10-23(230-232)
Goldstein, Lewis P.
— Development and Evaluation of a New Artificial Larynx. Contractor Reports: L. Goldstein, H. Rothman, and C. Oliver (VA Hospital, Gainesville, Florida) 10-29(186) 10-30(278-279)
Goodrich, Gregory L.
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, and A. Wood (Western Blind Rehab. Center, VA Hospital, Palo Alto, Calif.) 10-23(339-341) K. Wiley 10-24(267-268) 10-25(223-227) 10-26(354-359) 10-27(Report incorporated into article under "A Preliminary Followup Study of Electronic Travel Aids Users" 82-91) 10-28(232-235) H.S. Paul 10-29(171-173) 10-30(272-273)
— A Preliminary Followup Study of Electronic Travel Aid Users: N.C. Darling, G.L. Goodrich, and J.K. Wiley 10-27(82-91)
Gorran, Jody A.
— Wheel or Geriatrics Chair Cushion. Recent Patents 10-29(196)
Gossalin, Gilles
— New Head Control for Quadriplegic Patients: Y. Lozac'h, G. Gossalin, E.D. Sherman, G. Gingras, and M. Ritchuk 10-23(151-157)
Graphite-Epoxy Composite Components
— Effort to Fabricate Knee Joint Fails, VAPC Research Report 10-27(93-94) 10-29(80)
— Graphite-Epoxy Composite Shank for Partial Thigh Endoskeletal Prostheses
— VAPC Research Report 10-23(220-221) 10-25(136) 10-26(216) 10-28(93)

— Graphite-Epoxy Composite Shank, Northrop Corp., Hawthorne, Calif., VAPC Research Report 10-21(72) 10-23(220-221)

— Graphite-Epoxy Knee Joint for Below-Knee Prosthesis 10-26(216) 10-29(80)
— Graphite-Epoxy SACH Foot Keels 10-26(216) 10-27(94)
Graupe, Daniel
— Control of an Artificial Upper Limb in Three Degrees of Freedom. Contractor Reports: D. Graupe (Colorado State University, Fort Collins, Colo.) 10-21(139-141) 10-24(236-238)
Graupe, Daniel
— Control of an Artificial Upper Limb in Several Degrees of Freedom. Contractor Reports: D. Graupe, T.E. Kaplan, and W. Monlux (Colorado State University, Fort Collins, Colo.) 10-22(226-236) 10-23(312-315) 10-25(206-207) 10-26(320-322) 10-27(155-157) 10-28(178-179) 10-29(107-108) 10-30(182-183)
— Development of a Hearing-Aid System with Independently Adjustable Subranges of Its Spectrum Using Microprocessor Hardware. Contractor Reports: D. Graupe (Colorado State University, Fort Collins, Colo.) and G.D. Causey (University of Maryland, College Park, Md.) 10-23(351-352) 10-24(274-275) 10-25(241-242) 10-26(363-364) 10-27(199-200) 10-28(241-242) 10-29(178-179) 10-30(275-276)
— Method of and Means for Scrambling and Descrambling Speech at Audio Frequencies. Recent Patents 10-29(195) 10-30(289)
— Method and Means for Adaptively Filtering Near-Stationary Noise from Speech. Recent Patents 10-30(289)
— A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals Using Microprocessors: D. Graupe, A.A.M. Beex, W.J. Monlux, and I. Magnussen 10-27(4-16)
Gravity Activated Prosthetic Device
— Recent Patents: Russell S. Crapanzano 10-22(528)
Green, Robert
— The Current Status of and Future Considerations for Environmental Control Systems: R. Green 10-22(310-325)
Greenlaw, Robert K.
— Spinal Column Prosthesis/Orthosis. Recent Patents 10-30(291)
Griffin, Paul P.
— Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects. Contractor Reports: P.P. Griffin, and R.G. Shiavi (VA Hospital, Nashville, Tenn.) 10-29(144-145) 10-30(217-223)
Grip (of a Cane)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Specifications 10-30(48-49)
Guardian Folding Walker

— VAPC Research Report 10-26(242-244)
Guardian Products Co., Inc., Memphis, Tenn.
— Manufacturer, Guardian Folding Walker 10-26(242-244)
Gurneys
— ConVaid Mobile Prone Stander, 10-25(156-158)
Gyro-Gym Therapeutic Exerciser
— VAPC Research Report 10-26(262-263)

H

Haber, Paul A.L.
— Heads VA Program for Aging Veterans. Notes and News 10-25(252-253)
The Hadley School for the Blind, Winnetka, Illinois
— Development of Correspondence Courses for Personal Reading Aids for the Blind. Contractor Reports: D.W. Hathaway and M. Butow 10-21(162-163)
— Instruction In, and Evaluation of, Reading Machine Techniques. Contractor Reports: D.W. Hathaway, M. Butow, and R.D. Rouse 10-23(339) 10-24(266-267) 10-25(222-223) 10-26(354)
— Research and Evaluation of *Audible Output Print Reading Aids* for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Teaching the Stereotoner: its Problems and Rewards: Margaret Butow 10-22(433-435)
Hall, Albert D.
— Below-Knee Amputation with Immediate Postoperative Fitting of Prosthesis. Contractor Reports: W.S. Moore, A.D. Hall, and L.A. Wilson (VA Hospital, San Francisco, Calif.) 10-23(300) 10-24(225 no report) 10-25(200 no report) 10-26(307) 10-27(142 no report)
— Below-Knee Amputation for Vascular Insufficiency with Immediate Postoperative Fitting of Prosthesis. Contractor Reports: W.S. Moore, A.D. Hall, and L.A. Wilson (VA Hospital, San Francisco, Calif.) 10-21(128)
Hall, Matthew
— Pressure Distribution Pad Assembly for Wheelchairs. Recent Patents 10-27(209)
Hall, C. William
— Developing a Permanently Attached Artificial Limb: C.W. Hall 10-22(144-157)
— Permanently Attached Artificial Limbs. Contractor Reports: C.W. Hall (Southwest Research Institute, San Antonio, Texas)

10-21(145 no report) 10-23(321-327) 10-24(243-249) 10-25(211) 10-26(331 — Period of BPR 10-25 and 10-26 covered by article "Skeletal Extension Development — Criteria for Future Designs 10-25(69-96)) Also William Mallow 10-27(165-168) 10-28(188-191) 10-29(155-158) 10-30(245-248)
— Skeletal Extension Development: Criteria for Future Designs: C.W. Hall, P.H. Cox, and W.A. Mallow 10-25(69-97)
Hall, Thomas D.
— Orthopedic Heel. Recent Patents 10-22(529)
Hampton, Fred R.
— Development of Refined Fitting Procedures for Lower-Limb Prostheses — Case Studies of Applied Research in Orthotics and Prosthetics — A Final Report. Contractor Reports: Augusto Sarmiento, Newton C. McCollough III, Loren L. Latta, and Fred R. Hampton (University of Miami School of Medicine, Miami, Florida) 10-28(162-178)
Hand Control Apparatus for an Aircraft Usable by a Person Lacking Use of His Legs
— Recent Patents: Bernard Morin 10-26(375)
Hand Controls (Automotive Adaptive Driving Aids) *see* Automotive Driving Aids
Handel, Alexander F.
— Recipient of 1974 Migel Medal. *Notes and News* 10-22(526-527)
Handicar TVE (Teillrot Voiture Electrique)
— VAPC Research Report 10-30(143-144)
Handi-Cup
— VAPC Research Report 10-30(147)
Hand Orthoses
— Electric Opponens-Type Hand Splint, VAPC Research Report 10-23(226-228)
— Patient Evaluation of a Functional Electrical Stimulation Hand Orthosis. Contractor Reports: P.H. Peckham (VA Hospital, Wade Park, Cleveland, Ohio) 10-26(344) 10-27(174-176) 10-28(214-218) 10-29(130-132) 10-30(201-203)
— Chronically Indwelling Percutaneous Coiled Wire Active Electrodes 10-28(215) 10-30(203)
— Control Logic 10-28(215-216) 10-29(131)
— Device Design and Fabrication 10-28(216-218)
— Laboratory Development 10-29(131-132)
— Operation of the System 10-28(215-216) 10-29(130-131)
— Patient Evaluation 10-28(218) 10-29(132) 10-30(202-203)
— Stimulator Development 10-29(130) 10-30(202)
— VAPC Powered Wrist-Hand Orthosis 10-24(162-163)
Hand Prostheses
— Supplemental Sensory Feedback for the VA/NU Myoelectric

Hand. Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case and Charles M. Scott 10-26(170-191)
— *See also* Northwestern University, VA/Northwestern Myoelectric Hand Systems; *also* Synergetic Hand and Hook
— *See also* Prostheses, Prosthetics, Upper-Limb Prostheses
Harden, David (Detroit Institute of Rehabilitation)
— Harden Control for Automotive Driving Aids, VAPC Research Report 10-23(253-255)
Harness
— Electrocutaneous Feedback for Artificial Limbs. Summary Progress Report. February 1, 1974, through July 31, 1975: Ronald E. Prior and John Lyman 10-24(3-37)
— Refinement and Clinical Evaluation of Harness-Mounted Proportional Controllers 10-24(23-28)
— Design and Evaluation of a Prosthesis Control Harness for Use by Non-Amputees 10-24(28-29)
— Pattern Recognition Arm Prosthesis—A Final Report—R. Wirta, D.R. Taylor, and F.R. Finley 10-30(8-46)
— Socket and Harnessing 10-30(21-22)
Harris, E.E.
— Orthotics Workshop: E.E. Harris 10-22(496-502)
Haskins Laboratories, New Haven, Connecticut
— The Current Status of Reading Machine Research at Haskins Laboratories: Franklin S. Cooper 10-22(439-442)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Background 10-30(75-77)
— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: Franklin S. Cooper, Jane H. Gaitenby, Frances Ingemann, Ignatius G. Mattingly, Patrick W. Nye, and Linda Shockey 10-21(153-158) 10-23(331-335) 10-24(256-261) 10-25(216-218) 10-26(344-348) 10-27(185-187) Andrea Levitt 10-28(225-228) 10-29(173-177) 10-30(273-275)
Hassler, Craig R.
— Method and System for Control of a Powered Prosthetic Device. Recent Patents 10-26(376)
Hathaway, Donald W.
— Development of Correspondence Courses for Personal Reading Aids for the Blind. Contractor Reports: D.W. Hathaway, and Margaret Butow (The Hadley School for the Blind, Winnetka, Ill.) 10-21(162-163)
— Instruction In, and Evaluation Of, Reading Machine Techniques. Contractor Reports: D.W. Hathaway, M. Butow, and R.D. Rouse (The Hadley School for the Blind, Winnetka, Ill.) 10-23(339) 10-24(266-267) 10-25(222-223)
Haupt, Werner

— Artificial Foot with Ankle Joint. Recent Patents 10-27(208)
Haverford College, Haverford, Pennsylvania
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Background 10-30(75-77)
The Hayes Pneumatic Control for Wheelchairs
— VAPC Research Report 10-21(97)
Head Actuated Control Apparatus for Battery-Powered Wheelchair
— Recent Patents: William Wanet Miller, III 10-30(288)
Head Control For Wheelchairs
— New Head Control for Quadriplegic Patients: Yves Losac'h, Gilles Gossalin, E. David Sherman, Gustav Gingras, and Mary Ritchuk 10-23(151-157)
Head Control *see also* Wheelchair Head Control
Head Position Training
— Biofeedback: Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
— Clinical Research with Cerebral Palsied Children 10-25(28-34)
Head Shadow Effect
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. A Final Report: Raymond T. Carhart and Lamar Young 10-26(9-45)
— Head Shadow Effect 10-26(11)
Health Care Systems Design
— Design Training Program in Health Care Systems. Notes and News 10-21(175)
Health Research, Inc., New York
— VAPC Contractor to Develop Test Standards Governing Quality of Wheelchair Cushions, VAPC Contractual Development Program 10-24(207)
Hearing Aids
— Compression Amplification and Speech Intelligibility in Noise. Contractor Reports: J.J. Sung (VA Hospital, Pittsburgh, Pennsylvania) 10-27(199) 10-28(240-241) 10-29(185-186, A Final Report)
— Development of a Hearing-Aid System With Independently Adjustable Subranges of its Spectrum Using Microprocessor Hardware. Contractor Reports: D. Graupe (Colorado State University, Fort Collins, Colorado) and G.D. Causey (University of Maryland, College Park, Maryland) 10-23(351-352) 10-24(274-275) 10-25(241-242) 10-26(363-364) 10-27(199-200) 10-28(241-242) 10-29(178-179) 10-30(275-276)
— The Development of Improved Techniques for the Analysis of Hearing-Aid Performance. Contractor Reports: G. Donald Causey, Earleen Elkins, and Lucille Beck (University of Maryland, BioCommunications Laboratory, College Park, Maryland)

10-23(342-346) 10-24(269, no report) 10-25(231-233) 10-26(357-360) Jerry Punch, and Howard C. Schweitzer (VA Hospital, Washington, D.C.) 10-27(191-196) 10-28(235-238) 10-29(179-185) 10-30(276-278)
— Analysis of the Effectiveness of Dichotic Signal Processing 10-28(238)
— Binaural High-Frequency-Emphasis Amplification 10-28(238)
— Collection of Three-Band Listening Level Data 10-28(237-238)
— Determination of Format Transition Thresholds as a Function of Compression Hearing Aid Processing 10-28(236-237)
— Development of Signal/Noise Evaluation for Compression Aid 10-28(237)
— Developmental Measurement Techniques 10-27(192-193)
— Effect of Release Time in Compression Hearing Aids 10-23(342-343)
— Hearing Aid Processing 10-27(193)
— Hearing-Aid-Quality Judgments 10-28(235-236) 10-29(180-181)
— Insertion Gain Measurements on KEMAR 10-27(194-196)
— Investigation of Signal/Noise Ratio Measurement 10-29(182-183)
— KEMAR and Behavioral Gain Measures 10-23(344-345)
— Listener-Assessed Intelligibility of Aided Speech 10-29(181-182)
— Problems Inherent in Use of KEMAR 10-26(359-360)
— Rank-Ordering of Aids by Clinical Audiologists 10-25(231-232)
— The Relation of Measurements on KEMAR to Behavioral Performance 10-29(183-184)
— Shelf Life 10-23(345-346)
— Speech Intelligibility Materials 10-23(344)
— Study of Aided-Speech Quality Judgments 10-27(193)
— Transient Distortion 10-28(236)
— The Use of High-Pass Hearing Aids 10-23(343)
— Variability Among Samples of Hearing Aid Models 10-29(179-180)
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. Contractor Reports: R. Carhart, and Wayne O. Olsen (Northwestern University, Evanston, Illinois) 10-21(165-166) L. Young 10-23(341-342) 10-24(268-269) 10-25(227-231) 10-26(356-357, Report incorporated into article as a Final Report under same title, pp. 9-45)
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. A Final Report: Raymond T. Carhart and Lamar Young 10-26(9-45)

— Bibliography of Articles Resulting From Work Supported by The Veterans Administration 10-25(43-44)
— A Summary of the Work Completed Under Earlier Contracts 10-26(10-14)
— Binaural Squelch Effect 10-26(12-13)
— CROS and BICROS Aids Described 10-26(12-13)
— Discrimination of Speech in Quiet and in Noise 10-26(10-11)
— Head Shadow Effect 10-26(11)
— Work Completed Under Current Contract 10-26(14-40)
— The Effects of Amplitude Compression on Speech Intelligibility 10-26(31-40)
— The Effects of Peak Clipping on Speech Intelligibility 10-26(14-31)
— Retaining Linguistic Information 10-26(23)
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Introduction 10-25(120-121)
— New Two-Year Test Rotation Program 10-25(122-127)
— Research and Development Aims 10-25(127-128)
— Test and Selection Program 10-25(121-122)
— Hearing Aids and the Veterans Administration: G. Donald Causey 10-22(55-63 and 424-426)
— Influence of Input and Gain Values Upon Electroacoustic Properties of Hearing Aids. Contractor Reports: G.D. Causey, E. Elkins, and L.B. Beck (University of Maryland, BioCommunications Laboratory, College Park, Maryland) 10-21(166-167)
— Research on Hearing-Aid Design: Raymond Carhart 10-22(420-423)

Hearing Aids (High-Pass and Regular)
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Test and Selection Program 10-25(121-122)

"Hearing-Ear Dogs" for the Deaf
— Notes and News 10-28(247-248)

Hearing-Impaired, Communicator
— Manual Communications Module (Typewriter-Phone-Teletype), VAPC Research Report 10-27(98)

Heart Recording
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Recording Electrodes 10-23(106-143)

Heart Stimulation
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)

— Heart Stimulation 10-23(75-86)
Heel Contact
— Physical Response of SACH Feet Under Laboratory Testing: R.L. Daher 10-23(4-50)
Heel Resistance
— Physical Response of SACH Feet Under Laboratory Testing; R.L. Daher 10-23(4-50)
— Discussion of Results 10-23(10-44)
Heel Surface Defects Covered by Pedicle Flaps
— Controlled Early Ambulation of Heel Surface Defects Covered by Pedicle Flaps in Lower-Limb Amputees: James H. Herndon, Alcide M. LaNoue, and Stanley P. Frileck 10-21(9-22)
Heimco Inc., Lakeland, Florida
— Heimco Nurse Call, VAPC Research Report 10-24(173-175)
Heiple, Kingsbury G.
— Fluted Hip Nail Implant System for Orthopaedic Surgery. Recent Patents 10-28(257)
— In Vivo Loading of Knee Joint Replacement. Contractor Reports: Richard H. Brown, Kingsbury G. Heiple, and Victor M. Goldberg (Case Western Reserve University, Cleveland, Ohio) 10-27(168 no report) 10-28(193-194) 10-29(137) 10-30(209-215)
Helen Hayes Hospital, West Haverstraw, New York
— Acceleration of Bone Healing by Electrical Stimulation. Contractor Reports: G.V.B. Cochran 10-25(208-209) 10-26(322) 10-27(157-158) 10-28(179-180) 10-29(136) 10-30(209)
Helen Keller National Center Dedicated
— Notes and News 10-28(245)
Helen Keller World Conference on Services to Deaf-Blind Adults
— Calendar of Events 10-26(385) 10-27(216)
Helen Keller World Conference
— Adopted the Declaration of Rights for the Deaf-Blind. Notes and News 10-28(245-246)
Helmer, Jerry D.
— Artificial Muscle. Recent Patents 10-24(284)
Helms, Arthur
— Receives Francis Campbell Citation. Notes and News 10-24(280)
Helmuth, Gene R.
— Functional Ankle for a Prosthetic Limb. Recent Patents 10-29(195)
Hemiplegia, Hemiplegic
— Ambulation Training
— Clinical Evaluation of a Sensory Feedback Device: The Limb Load Monitor 10-29(8-49)
— Patient Selection Criteria and Therapy Goals 10-29(16)

— Trial Results 10-29(16-31)
— Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects. Contractor Report: Paul P. Griffin, Richard Shiavi, Sherry Champion, and Frank Freeman (VA Hospital, Nashville, Tennessee) 10-30(217-223)
— Biofeedback (Myofeedback) in Rehabilitation for Hemiplegia 10-30
— Engineering Applications in Orthotic and Prosthetic Treatment of Musculoskeletal Defects. Contractor Reports: E. Byron Marsolais and Eduard Schulz (VA Hospital, Wade Park, Cleveland, Ohio)
— Comparison of Implanted Electrical Stimulation (NMA) to Other Methods of Treating the Equinovarus Foot 10-28(204-209) 10-29(128)
— Stimulation of the Paralyzed Hip to Return to Functional Use 10-28(209-210) 10-29(128-129)
Hemodynamic Evaluation of Postoperative and Preoperative Amputees
— Contractor Reports: Bok Y. Lee, Frieda S. Trainor, John L. Madden, Emilio Ejercito 10-21(142-143) 10-23(318-319) 10-24(239-240) David Kavner 10-25(209-210) 10-26(322-323) 10-27(158-161) 10-28(180-181) 10-29(125-127) 10-30(199-200)
— Above-Knee Amputations 10-30(200)
— Below-Knee Amputations 10-30(200)
— Conclusions 10-29(127)
— The Efficacy of Lumbar Sympathectomy in the Treatment of Gangrene of the Lower Limb 10-29(125-127)
— Non-Invasive Techniques as an Aid to Determination of Amputation Level 10-30(199)
Heomodynamic Evaluation in Selection of Amputation Level: Bok Y. Lee 10-22(85-104)
— Methods 10-22(85-86)
— Blood Velocity Detection or Doppler Ultrasonic Flowmetry 10-22(89)
— Electrical Impedance Plethysmography 10-22(89-90)
— Noninvasive Electromagnetic Flowmetry 10-22(90-91)
— Peripheral Pulse Transmission Time Analysis 10-22(94-95)
— Square Wave Electromagnetic Flowmetry 10-22(86-89)
— Thermistor-Thermometry and Liquid Crystal Thermography 10-22(92-93)
— Number of Amputations 10-22(101-103)
— Representative Case Studies 10-22(96-101)
— Development of Arteriosclerotic Disease in Stump of Amputated Limb 10-22(96-97)

— Level of Amputation 10-22(100-101)
— Prevention of Amputation 10-22(97-99)
Herndon, James H.
— Controlled Early Ambulation of Heel Surface Defects Covered by Pedicle Flaps in Lower-Limb Amputees: J.H. Herndon, A.M. Lanoue, and S.P. Frileck 10-21(9-22)
Hess Rotary Bed
— VAPC Research Report 10-26(250-251)
Hess, Walter, Dubendorf, Switzerland
— Manufacturer, Hess Rotary Bed, VAPC Research Report 10-26(250)
High Performance Cognodictor
— Research and Development in the Field of Reading Machines for the Blind: Glendon C. Smith and Hans A. Mauch 10-27(61-71)
High-Visibility Canes
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— High-Visibility Canes 10-30(55-56)
Hines VA Blind Rehabilitation Center
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— C-4 Laser Cane Evaluation 10-30(90)
Hines, Illinois *see* Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois
Hinge for Knee Brace
— Recent Patents: Leslie T. Applegate 10-30(288)
Hip Joint
— Studies of Normal and Abnormal Motion. Contractor Reports: M.P. Murray (VA Hospital, Wood, Wisconsin)
— Roentgenographic Measurements After Müller Total Hip Replacements 10-29(141)
— Total Hip Joint Replacement Study 10-29(140-141)
— Polypropylene Hip Joint and Pelvic Band 10-25(136)
— Stimulation of the Paralyzed Hip to Return to Functional Use *see* Hemiplegia (Engineering Applications etc.) *see also* Gait
Hip Nails *see* Biomaterials
Hobson, Douglas A.
— Computer Optimization of Polycentric Prosthetic Knee Mechanisms: D.A. Hobson and L.E. Torfason 10-23(187-201)
— Lower-Limb Prosthetics Workshop: D.A. Hobson 10-22(490-495)
— A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W.R. Dyck, S. Onyshko, D.A. Hobson, D.A. Winter, and A.O. Quanbury 10-25(169-186)
Hofstra, Peter C.
— The Clinical Engineer and the Spinal-Cord-Injured Person: P.C. Hofstra 10-22(37-40)

Hohn, Richard E.
— Method and Apparatus for Programming a Computer Operated Robot Arm. Recent Patents 10-26(376)
Hoists *see* Patient Lifts and Transfer Aids
Holecek, Otto C.
— Vehicle Invalid Lift Device. Recent Patents 10-29(196)
Holsberg, Wilfred G.
— Honored by BVA. Notes and News 10-22(526)
— Twenty-Five Years of Progress: Monroe J. Gershenson and Wilfred G. Holsberg 10-21(3-8)
Homsy, Charles A.
— Implantable Structure. Recent Patents 10-30(288)
Hoover, Richard E.
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Background 10-30(75-77)
— The Long Cane 10-30(48)
Horner, Patricia
— Dr. Weller Names Patricia Horner to AEMB Executive Post. Notes and News 10-26(370)
Horvath, Eduard
— Artificial Wrist and Arm Prosthesis. Recent Patents 10-28(257)
— System for Operating a Prosthetic Limb. Recent Patents 10-23(360)
Hoshall, Charles H.
— Myoelectrically Controlled Prosthesis. Recent Patents 10-27(209)
Hosmer-Dorrance, Inc., Campbell, Calif.
— APRL Voluntary Closing Hook, Annual Compliance Testing, VAPC Research Report 10-30(174)
— Contract to Develop Graphite-Epoxy SACH Foot Keel, VAPC Research Report 10-27(94)
— Electrically Powered Orthoses, VAPC Research Report 10-21(79)
— External Elbow Assembly, Annual Compliance Testing, VAPC Research Report 10-28(129)
— Internal Elbow Assembly, Annual Compliance Testing, VAPC Research Report 10-30(174)
— Voluntary Closing Hand, Annual Compliance Testing, VAPC Research Report 10-28(129)
Hotel's Willingness to Renovate for Accessibility Won White House Conference Choice
— Notes and News 10-26(367-368)
Houston, Vern L.
— Clinical Application Study of External Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: E.A. Lewis, C.R. Sheredos,

T.T. Sowell, and V.L. Houston 10-24(51-136)
Hrouda, Oldrich
— Apparatus for the Identification of Size Numbers of Right and Left Lasts. Recent Patents 10-30(287)
Hughes, Kenneth E.
— Artificial Muscle. Recent Patents 10-24(284)
Hugh Steeper, Ltd., London, England
— Steeper Continuously Rotating Bed, VAPC Research Report 10-26(247-249)
Human Locomotion *see* Gait Analysis
Human Skin
— A Device Designed to Approximate Shear Forces On Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— *See also* Bed Sores, Decubitus Ulcers, Hunter Color Difference System, Pressure Sore Prevention and Therapy Systems
Humeral Flexion
— Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior and Charles M. Scott 10-24(43-50)
— Background 10-24(43-46)
— Device Description 10-24(46-49)
Humidity
— A Device Designed to Approximate Shear Forces on Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— Introduction 10-30(37-38)
Hunter Color Difference System
— The First International Symposium On Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
— Maxillofacial Restorative Materials and Techniques. Contractor Reports: John F. Lontz and James W. Schweiger (Temple University and VA Hospital, Wilmington, Delaware)
— Color Standardization 10-27(327-328)
— Digital Color Difference Index, Human Skin and Artificial Pigments 10-27(161-165)
— Intrinsic Pigmentation—Reproducibility of Quality and Product Specifications 10-30(227-230)
— Pigmentation and Cosmetic Matching 10-28(185-186)
— Stability to Actinic Exposure 10-27(325-326)
Hursen, Thomas F.
— Implantable Nerve Stimulator. Recent Patents 10-26(375)
Hycor
— Mobility Devices: Leicester W. Farmer 10-30(47-118)

— Folding or Collapsible Canes
— Hycor Autofold Cane 10-30(52-53)
— Hycor Autosupport Cane 10-30(52)
— Hycor Cable Cane 10-30(52-53)
Hydraulic Control Systems
— Research and Development in the Field of Artificial Limbs. Contractor Reports: Hans A. Mauch (Mauch Laboratories, Dayton, Ohio) 10-21(118-121) 10-23(279-281) 10-24(214-216) 10-25(179-182) 10-26(273-275) 10-27(121-126) 10-28(132-134)
— Hydraulic Ankle Control System 10-27(121-122) 10-28(132-133) 10-29(117-118)
— Hydraulic Knee Control System for Geriatric Amputees 10-27(122-123) 10-28(134)
— The Development of Artificial Limbs for Lower Limbs: Hans A. Mauch
— Development of the Hydraulic Ankle 10-22(162-164)
— Features of the Hydraulic Ankle 10-22(160-162)
Hydraulic Foot-Ankle System *see above* Hydraulic Control Systems (Mauch)
Hydraulic Flexion Control Device
— Recent Patents: Charles M. Scott 10-22(528)
Hydraulic Loop
— A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W.R. Dyck, S. Onyshko, D.A. Hobson, D.A. Winter, and A.O. Quanbury 10-23(169-186)
Hydraulic Prosthesis
— A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W.R. Dyck, S. Onyshko, D.A. Hobson, D.A. Winter, and A.O. Quanbury 10-23(169-186)
— Bench Testing of Hydraulic System 10-23(173-178)

I

Icarus Health Aids, Ltd., Netanya, Israel
— Icarus Easy-Transfer Wheelchair Attachment, VAPC Research Report 10-27(107-109) 10-29(87-90)
IEEE *see* Institute of Electrical and Electronic Engineers
Iles, Michael Victor
— Speech Synthesizing Apparatus. Recent Patents 10-30(291)
Illuminated Reachers for Wheelchairs
— VAPC Research Report 10-28(114)
Illumination

— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Common Characteristics of Low Vision 10-26(103-104)
— Luminance 10-26(53-54)
Immediate Postoperative Application of Upper-Limb Orthoses: Charles L. McDowell 10-22(404-405)
Immediate Postoperative Application of Upper-Limb Orthoses
— Contractor Reports: Charles L. McDowell. VA Hospital, Richmond, Virginia 10-21(137-138) 10-23(311, no report)
Immediate Postoperative Management
— Skin Blood Flow and Healing: Wesley S. Moore 10-22(105-108)
— Wound Healing: Ernest M. Burgess 10-22(109-113)
Immediate Postoperative Prostheses Research Study
— Contractor Reports: Ernest M. Burgess. Prosthetics Research Study, Seattle, Washington 10-21(126-127) 10-23(290-299) 10-24(222-225) 10-25(198-203) 10-26(301-306) 10-27(137-142) 10-28(152-156) 10-29(123-124) 10-30(197-198)
— Affiliated Research 10-23(299)
— Alternating Leg Pressure Units (ALP 501) 10-23(299)
— Atlas of Orthopedic Appliances 10-23(299)
— Chemonucleolysis 10-23(299)
— Amputation Surgery and Amputee Rehabilitation 10-23(290-292)
— Amputation Surgery and Wound Healing 10-24(224-225)
— Amputee Discussion Groups 10-27(138)
— Comment on Other Projects 10-25(199-200)
— Controlled Environmental Treatment 10-26(301-302) 10-27(138-139) 10-28(152-155)
— Electrospinal Instrumentation (ESI) 10-27(140)
— Engineering 10-24(223)
— Functional Capabilities Study 10-26(304) 10-27(138) 10-28(156)
— Functional and Stress Analysis of Lower-Limb Amputees Performing Extra-Ambulatory Activities 10-27(141-142) 10-28(155)
— Functional Electrical Stimulation 10-26(303-304) 10-27(140-141)
— Modulated Air Controlled Environment (MACE) 10-27(139)
— Multi-Leg Attachment Device 10-26(304)
— Neuromuscular Assist (NMA) 10-27(140)
— Physiological Suspension Study 10-23(304-305) 10-27(141) 10-28(155)
— Preamputation Level Determination and Skin Blood Flow Research 10-26(302-303)

— Prosthetics Research 10-23(292-297) 10-24(223-224)
— AK Casting Brim Technique 10-23(293-294)
— Child Prosthetics 10-23(294)
— Extra-Ambulatory Prostheses 10-23(294)
— Flexion Contracture Knee Joint 10-23(296)
— Phenolic Foot Attachment Insert 10-23(294)
— Prosthetic Education 10-23(296-297)
— PRS-Moore Cast Load Cell 10-23(296)
— PRS Moore Prosthetic Load Cell 10-23(295-296) 10-26(304) 10-27(141)
— Socket Suspension 10-23(294-295)
— Symes Alignment Device 10-23(292-293)
— Torque Absorber 10-23(296)
— Rancho Edema Control System 10-27(139)
— Revision Amputation 10-28(156)
— Seattle VA Hospital Amputee Service 10-26(305) 10-27(137) 10-28(156)
— Strain Gages Monitor Surface Skin Tension 10-27(140)
— Studies of Skin Blood Flow as Related to Amputation Level 10-28(155)
— Transcutaneous Nerve Stimulation (TNS) 10-27(141)
— Two Electromedical Projects 10-25(198-199)
— The Use of External Electrical Energy in Neuromuscular Rehabilitation 10-23(297-299) — *see also* Neuromuscular Stimulation
— Xenon 133 Testing 10-27(139-140)

Immediate Postoperative Prostheses
— Below-Knee Amputation With Immediate Postoperative Fitting of Prosthesis. Contractor Reports: W.S. Moore, A.D. Hall, and L.A. Wilson (VA Hospital, San Francisco, California) 10-21(128) 10-23(300) 10-24(225 no report) 10-25(200 no report) 10-26(307) 10-27(142 no report) 10-28(156 no report) (VA Hospital, Tucson, Arizona) 10-29(124-125) 10-30(199)

Implantable Electromagnetic Hearing Aid
— Recent Patents: John M. Fredrickson 10-23(358)

Implantable Nerve Stimulator
— Recent Patents: Thomas F. Hursen and Steve A. Kolenik 10-26(375)

Implantable Neural Electrode
— Recent Patents: R.B. Stein, Dean Charles, and Allan Mannard 10-28(258)

Implantable Structure
— Recent Patents: Charles A. Homsy 10-30(288)

Implants
— The First International Symposium On Facial Prosthetics, Arn-

hem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
— *See also* Electrodes, Permanently Attached Artificial Limbs
The Importance of Amputation-Level Determination
— Guest Editorial: Wesley S. Moore 10-28(1-3)
Improved Suspension for Wrist Disarticulation Prostheses
— VAPC Research Report 10-28(95)
The Improvement of Assistive Systems Through Research, Design, Clinical Testing and Team Evaluation
— Contractor Reports: P.H. Newell, Jr. and L.A. Leavitt. Texas A&M University College of Engineering, Bioengineering Program, College Station, Texas 10-21(138-139) 10-23(312)
The Improvement of Prosthetic and Orthotic Devices Through Materials Research, Analysis, Design, Clinical Testing, and Team Evaluation
— Contractor Reports: M. McDermott, and L.A. Leavitt. Texas A&M University College of Engineering, Bioengineering Program, College Station, Texas 10-24(235-236)
IMSECO *see* International Medical Seating and Equipment Corp.
— Patient Transfer System, VAPC Research Report 10-24(191-192)
I.N.A.I.L. (Instituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro Vigorso di Budrio (Bologna) Italy
— The I.N.A.I.L. Experience Fitting Upper Limb Dysmelia Patients with Myoelectric Control: Hannes Schmidl 10-27(17-42)
— Body-Powered Prosthesis Elements 10-27(24-28)
— Pneumatic vs. Electric Prosthesis Power: Some Technical Specifications Compared (chart) 10-27(20)
— Residual Limb Function as a Critical Factor in the Design of a Prosthesis and Its Control System 10-27(21-40)
— Socket Design 10-27(29-31)
— Thalidomide and Dysmelia 10-27(17)
INA MEND Institute, Human Resources Center
— Publishes "Vocational and Educational Opportunities for the Disabled." Notes and News 10-27(202-203)
Independence Powered Recliner Kit
— VAPC Research Report 10-30(131-133)
Independence Wheelchair
— VAPC Research Report 10-23(237-238)
"Independence With Dignity: Action '78"
— Theme of 2nd National Conference on Aging and Blindness. Notes and News 10-28(246)
Index to Bulletin of Prosthetics Research
— BPR 10-1 through BPR 10-20. 10-21(189-420)
— BPR 10-21 and BPR 10-22. 10-23(368-399)
— BPR 10-23 and BPR 10-24. 10-25(268-298)

— BPR 10-25 and BPR 10-26. 10-28(267-330)
— BPR 10-27 and BPR 10-28. 10-29(204-268)
— The First Ten Years — an Index. Editorial: Earl A. Lewis 10-21(1-2)
Index of Characteristics
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Test and Selection Program 10-25(121-122)
Indoor-Outdoor Wheelchair
— VAPC Research Report 10-23(235-236) 10-26(232-234)
Indoor-Outdoor Wheelchair Frame
— Recent Patents: Keith S. Rodaway 10-25(259)
Inflatable Device for Healing of Tissue
— Recent Patents: Roy Lapidus 10-26(375)
Inflatable Sole Shoe
— Recent Patents: Dennis J. Gager 10-28(257)
Inflation Device for a Pneumatic Orthosis
— Recent Patents: Donald K. Shaffer 10-29(195)
Influence of Input and Gain Values Upon Electroacoustic Properties of Hearing Aids
— Contractor Reports: G.D. Causey, E. Elkins, and L.B. Beck. University of Maryland, BioCommunications Laboratory, College Park, Maryland 10-21(166-167)
Ingemann, Frances
— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: F.S. Copper, J.H. Gaitenby, F. Ingemann, I.G. Mattingly, P.W. Nye, and L. Shockey (Haskins Laboratories, Inc., New Haven, Conn.) 10-26(344-348) 10-27(185-187) 10-28(225-228)
Inman, Verne T.
— Author of "The Joints of the Ankle" Culminates Two Decades of Studies. Notes and News 10-27(201-202)
Insta Gaiter
— VAPC Research Report 10-28(110-111)
Institute of Electrical and Electronic Engineers (IEEE)
— Applications of Electronics in Medicine. Calendar of Events 10-24(292)
— Electrical Engineering for this Decade. Calendar of Events 10-24(292)
— International Conference on Acoustics, Speech, and Signal Processing. Calendar of Events 10-26(384)
Institute of Electrical and Electronic Engineers (IEEE) *see also* Conference on Engineering in Medicine and Biology
Instruction In, and Evaluation of, Reading Machine Techniques

— Contractor Reports: D.W. Hathaway, M. Butow, and R.D. Rouse. The Hadley School for the Blind, Winnetka, Illinois 10-23(339) 10-24(266-267) 10-25(222-223) 10-26(254, Report incorporated in article entitled "Research and Evaluation of Audible Output Print Reading Aids for the Blind — A Final Report" 10-26(139-169)
Instrument Components Co., Inc., Mentor, Ohio
— Insta Gaiter Electromechanical Power Conversion Kit for Manual Wheelchairs, VAPC Research Report 10-28(110-111)
Integral-Skin Cushion-Molding Apparatus
— Recent Patents: Kurt Moser 10-30(289)
Integration of the Handicapped
— ". . . And I Say to You Tonight That the Time for Discrimination Against the Handicapped . . . is Over." Notes and News 10-28(249-250)
Interagency Conference on Rehabilitation Engineering
— Calendar of Events 10-30(299-301)
— Notes and News 10-30(283-284)
Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prostheses and Orthoses
— Contractor Reports: W. Seamone and G. Schmeisser, Jr. The Johns Hopkins University, Applied Physics Laboratory, Silver Spring, Maryland 10-21(128-136) 10-23(300-310) 10-24(225-234) 10-25(200-203) 10-26(307-316) 10-27(142-149) 10-28(157-162) 10-29(109-117) 10-30(185-192)
— *See also* detailed entry at Upper-Limb Prosthetics
Interface Pressures in the Below-Knee Prosthesis (Physiological Suspension) — an Interim Report: Ernest M. Burgess and A. James Moore 10-28(58-70)
Intermediate Dark-Focus
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Two Modes of Processing Visual Information 10-26(55-56)
Internal Elbow Assembly (Compliance Testing)
— VAPC Research Report 10-27(117) 10-30(174)
International Agency for the Prevention of Blindness
— General Assembly. Calendar of Events 10-28(264)
International Association for Prevention of Blindness Conference
— Calendar of Events 10-25(267) 10-26(386) 10-27(218) 10-28(265) 10-29(201)
International Association of Rehabilitation Medicine
— 2nd International Congress. Calendar of Events 10-21(186)
International Biomaterials Symposium *see* The Society for Biomaterials

International Business Machines Corp.
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Background and Information 10-30(8-9)
International Conference on Cybernetics and Society
— Calendar of Events 10-25(265)
International Conference on the Evaluation of Biomaterials
— 1st. Calendar of Events 10-27(216)
International Conference on Legislation Concerning the Disabled
— 2d. Calendar of Events 10-26(385) 10-27(216)
International Congress on Acoustics
— Calendar of Events 10-24(293) 10-25(266) 10-26(384)
International Congress of Biomechanics
— 5th Congress. Calendar of Events 10-22(537)
— 6th Congress. Calendar of Events 10-26(384)
International Congress on Biorheology
— 3rd Congress. Calendar of Events 10-28(264)
International Congress on Education of the Deaf
— Calendar of Events 10-22(537)
International Congress on "Improving the Quality of Life of the Handicapped with Assistive Devices"
— 3rd Congress. Calendar of Events 10-29(202) 10-30(300)
International Congress of Physical Medicine and Rehabilitation
— 7th Congress. Calendar of Events 10-22(537) 10-23(366) 10-24(292)
International Fair for the Rehabilitation and Integration of the Disabled
— Rehamex '78. Calendar of Events 10-28(264)
International Federation of Physical Medicine and Rehabilitation
— 8th Congress. Calendar of Events 10-29(203) 10-30(301)
International Guide to Aids and Appliances for Blind and Visually Impaired Persons
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Specifications 10-30(48-49)
International Journal of Rehabilitation Research
— Notes and News 10-30(281-282)
International Organization for Medical Physics
— 4th International Conference. Calendar of Events 10-23(366) 10-24(292)
International Marketing Program, New York, New York
— Newton Ultra Lightweight Wheelchair, VAPC Research Report 10-23(240)
International Medical Seating and Equipment Corp. (IMSECO), Omaha, Nebraska

— Orthopedic Seating System, VAPC Research Report 10-24(191-192)
— Patient Transfer System, VAPC Research Report 10-24(193-194)
International Organization for Standardization (ISO)
— More Concern for Needs of Physically Handicapped Likely in International Technical Standards. Notes and News 10-28(250-251)
International Rehabilitation Medicine Association
— 3rd World Congress. Calendar of Events. 10-25(266) 10-26(386) 10-27(217) 10-28(264)
— 4th World Congress. Calendar of Events. 10-24(294) 10-25(266) 10-29(203) 10-30(301)
International Society of Electrophysiological Kinesiology
— 3rd Congress. Calendar of Events 10-24(293)
— 4th Congress. Calendar of Events 10-30(299)
International Society of Orthopedic Surgery and Traumatology
— 13th Congress. Calendar of Events 10-21(186) 10-22(537)
International Society for Prosthetics and Orthotics (ISPO)
— Calendar of Events 10-21(186) 10-22(538) 10-23(366) 10-24(293) 10-25(266) 10-26(384-387) 10-27(218) 10-28(266) 10-29(203) 10-30(301)
— ISPO Collaborative Program, VAPC Research Report 10-24(199-200)
— ISPO—International Key to the Future in Aiding the Handicapped (Editorial) Anthony Staros 10-27(1-3)
— ISPO's New "Prosthetics and Orthotics International" Begins Publication with April 1977 Issue
— Notes and News 10-27(201)
— Publishes "Prosthetics and Orthotics International." Notes and News 10-27(201)
International Symposium on External Control of Human Extremities
— 6th Symposium. Calendar of Events 10-27(217) 10-28(264)
International Symposium for Facial Prostheses
— 1st International Symposium on Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976 (Summary): John F. Lontz 10-25(129-133)
— Second International Symposium for Facial Prostheses at San Antonio, Texas, May 1978. Notes and News 10-26(366)
— 2nd Symposium. Calendar of Events 10-26(386) 10-27(217) 10-28(266) 10-29(203) 10-30(301)
"International Year for Disabled Persons"
— Proclaimed in 1981 by United Nations. Notes and News 10-27(205)
In-the-Ear Hearing Aid
— The Hearing-Aid Program of the Veterans Administration:

Twenty Years of Service: G. Donald Causey 10-25(120-128)
— New Two-Year Test Rotation Program 10-25(122-127)
Intracardiac Recording
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Recording Electrodes 10-23(106-143)
Introductory Remarks (VA Conference of Prosthetics and Sensory Aids): Thomas J. Radley 10-22(9)
Invacare Corp., Elyria, Ohio
— Elite Series 800 Wheelchair, VAPC Research Report 10-27(108-110)
Invalid Lifting and Walking Device
— Recent Patents: Dale H. Thomas 10-27(209)
An Invitation to Visit New York in the Springtime from ISPO 1977 World Congress, May 26-June 2
— Notes and News 10-26(365-366)
In Vivo Loading on Knee Joint Replacement: Albert H. Burstein, Victor H. Frankel, and E.B. Marsolais 10-22(193-199)
In Vivo Loading of Knee Joint Replacement
— Contractor Reports: A.H. Burstein, V.H. Frankel. Case Western Reserve University, Biomechanics Laboratory, Cleveland, Ohio 10-24(253-254) 10-25(214) R. Brown 10-26(339-340) K.G. Heiple, V.M. Goldberg 10-27(168 no report) 10-28(193-194) 10-29(137) 10-30(209-215)
— Total Condylar Joint Replacement Approach to Telemetry Study 10-30(209-215)
Ischemia
— Edge Light: a New Approach to Studying the Microvascularization of the Skin 10-29(65-78)
— *See also* Amputation Level, Blood Flow, Controlled Environment Chamber, Hemodynamic Evaluation
Isotorque Ankle Dorsiflexor
— VAPC Research Report 10-21(106-107)
ISPO *see* International Society for Prosthetics and Orthotics

J

Jacob, Ezekiel J.
— Method of Raised Xerographic Printing and Product. Recent Patents 10-25(257)
Jacobi, Jorge D.
— Spinal-Cord-Injury Studies: Paralysis, Spasticity, and Pain. Con-

tractor Reports: J.W. Gesink, M. Rosen, E. Falkenberg, and J.D. Jacobi (VA Hospital, Miami, Florida) 10-23(328-329) 10-24(250) 10-25(213)
Japan Sun Industries, Tokyo, Japan (rep. by J.A. Preston Corp., New York N.Y.)
— Sun Industries Curb-Climbing Wheelchair (Illust.), VAPC Research Report 10-28(106-107)
Javits, Jacob K.
— Recipient of 1974 Migel Medal. Notes and News 10-22(526-527)
Jenkins, Kenneth T.
— Elected President of Rehabilitation International at 13th World Conference. Notes and News 10-26(372-373)
Jensen, Howard
— Stair Climbing Tracked Vehicle. Recent Patents 10-23(360)
Jerard, Robert B.
— Bioelectrically Controlled Prosthetic Member. Recent Patents 10-24(284)
Johns Hopkins Remote-Manipulator
— VAPC Research Report 10-28(98)
— Evaluation of Medical Manipulators, University of California, Los Angles (Contractor Reports) 10-28(140-141) 10-29(106)
The Johns Hopkins University, Silver Spring, Maryland
— Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prostheses and Orthoses. Contractor Reports: W. Seamone and Gerhard Schmeisser, Jr. 10-21(128-136) 10-23(300-310) 10-24(225-243) 10-25(200-203) 10-26(307-316) 10-27(142-149) 10-28(157-162) 10-29(109-116) 10-30(185-193)
— Status of the Johns Hopkins Research Program on Upper-Limb Prosthesis-Orthosis Power and Control System: Woodrow Seamone and Gerhard Schmeisser, Jr. 10-22(237-244)
Joint Position Training
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
— Clinical Research with Cerebral Palsied Children 10-25(28-34)
Joint Rotation Device
— A Versatile Joint Rotation Device for Externally Energized Upper-Limb Prostheses: Paul Meadows and John Lyman 10-24(38-32)
"The Joints of the Ankle" by Verne T. Inman Culminates Two Decades of Studies
— Notes and News 10-27(201-202)
Joints *see also* Ankle Joints, Hip Joints, Knee Joints
Jouk Power-Aid Ambulator
— VAPC Research Report 10-24(185-187)

Jouk Standing Ambulator
— VAPC Research Report 10-26(241)

K

Kaplan, T.E.
— Control of an Artificial Upper Limb in Several Degrees of Freedom. Contractor Reports: D. Graupe, T.E. Kaplan, and W.J. Monlux (Colorado State University, Fort Collins, Colo.) 10-23(312-315)
Karchak, Andrew
— Adjustable Wheelchairs. Recent Patents 10-25(257)
— Wheelchair Drive Package. Recent Patents 10-25(258)
Kari-Fone Corp., Elmhurst, New York
— Portable Telephone, VAPC Research Report 10-27(99-100)
Kavner, David
— Hemodynamic Evaluation of Postoperative and Preoperative Amputees. Contractor Reports: B.Y. Lee, F.S. Trainor, D. Kavner, J.L. Madden, and E. Ejercito (VA Hospital, Castle Point, N.Y.) 10-25(210-211) 10-26(322-323) 10-27(158-161) 10-28(180-181) 10-29(125-127) 10-30(199-200)
Kay, Leslie
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Binaural Sensory Aids 10-30(98-102)
Kay, Hector W. 1909-1975
— Notes and News 10-23(355-356)
Keeton, J. Herbert
— Fluid-Filled Cushioning Assemblies. Recent Patents 10-29(195)
Kegel, Bernice
— A Survey of Lower-Limb Amputees: Prostheses, Phantom Sensations, and Psychosocial Aspects: B. Kegel, M.L. Carpenter, and E.M. Burgess 10-27(43-60)
Keith, Ernest Voshell
— Shock Absorber Attachment for Wheelchairs or the Like. Recent Patents 10-30(291)
Keith, William
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Binaural Sensory Aids 10-30(98-112)
Keitzer, Betty J.
— Check Writing Guide. Recent Patents 10-27(208)
Keitzer, John E.
— Check Writing Guide. Recent Patents 10-27(208)
Keller, Helen

— Bill Proposed to Rename Center in Honor of Helen Keller. Notes and News 10-25(246)
— *See also* Helen Keller
Kenedi, Robert Maximilian
— Elected to Membership in the National Academy of Engineering. Notes and News 10-26(374)
— A Kneeless Leg Prosthesis for the Elderly Amputee, Advanced Version: R. Seliktar and R.M. Kenedi 10-25(97-128)
Kessler, Henry H. 1896-1978
— Notes and News: Memorial Fellowship 10-29(194) Obituary 10-29(189-194)
Kinetics, Inc., South Bend, Indiana
— Super Voyager II Battery Powered Cart, VAPC Research Report 10-23(230-232)
Kingsley Manufacturing Co., Costa Mesa, Calif.
— Manufacturer, Mortensen Safety Knee, VAPC Research Report 10-28(93-94)
— SACH Feet Compliance Testing, VAPC Research Report 10-23(258)
— SACH Feet with Graphite-Epoxy Keels 10-28(93)
Kinney, Richard
— Story of Richard Kinney, Executive Director of the Hadley School. Notes and News 10-21(176)
Kissinger, Jeanette F.
— Edge Light: A New Approach to Studying the Microvascularization of the Skin: J.F. Kissinger, P.J. Verhonick, and D.W. Lewis 10-29(65-78)
Kleiner, Aaron
— A Description of the Kurzweil Reading Machine and a Status Report on its Testing and Dissemination: Aaron Kleiner and Raymond C. Kurzweil 10-27(72-81)
Knee Brace
— Recent Patents: Harris I. Gardner 10-22(528)
— Recent Patents: Robert R. Moore 10-23(358)
Knee Joint
— Computer Optimization of Polycentric Prosthetic Knee Mechanisms: Douglas A. Hobson and L.E. Torfason 10-23(187-201)
— Design of Prosthetic and Orthotic Devices. Contractor Reports: C.W. Radcliffe, D.M. Cunningham, J.M. Morris, and L. Lamoreux (University of California, Berkeley, California)
— Friction Stabilized Knee 10-26(292) 10-27(133) 10-28(142-144) 10-29(121) 10-30(193)
— Knee Disarticulation Prosthesis 10-21(125-126)

— Multi-Input Control and Knee Stability 10-28(148) 10-29(121-122) 10-30(194-195)
— *see also* Polycentric Knee
— Electromyographic Knee Control Systems, VAPC Research Report 10-24(157-160)
— In Vivo Loading on Knee Joint Replacement: Albert H. Burstein, Victor H. Frankel, and E.B. Marsolais 10-22(193-199)
— In Vivo Loading of Knee Joint Replacement. Contractor Reports: A.H. Burstein, H. Frankel (Case Western Reserve University, Cleveland, Ohio) 10-24(253-254) 10-25(214) R. Brown 10-26(339-340) K.G. Heiple, V.M. Goldberg 10-27(168 no report) 10-28(193-194) 10-29(137) 10-30(209-215)
— New Three-Part Knee Bolt Design. Contractor Reports: H.A. Mauch (Mauch Laboratories, Dayton, Ohio) 10-25(182) 10-26(274) 10-27(123-126) 10-29(120)
— Nylon Studied as Material for Knee Joint in BK Prostheses, VAPC Research Report 10-29(80)
— Polypropylene Fails as Knee Joint Material for BK Prostheses, VAPC Research Report 10-29(80)
— Studies of Normal and Abnormal Motion. Contractor Reports: Mary Patricia Murray (Kinesiology Research Laboratory, VA Center, Wood, Wisconsin
— Kinesiological Measurements of Functional Performance Before and After Geometric Total Knee Replacement 10-29(141-142)
— Maximum Isometric Knee Flexor and Extensor Muscle Contractions 10-29(142-143)

Knee Mechanism
— Computer Optimization of Polycentric Prosthetic Mechanisms: Douglas A. Hobson and L. E. Torfason 10-23(187-201)

Knee Orthoses
— Polypropylene Knee Orthosis with Suprapatellar Strap Suspension, VAPC Research Report 10-23(225)
— Polypropylene Knee Orthosis, VAPC Research Report 10-25(138)

Knee Prosthesis
— Recent Patents: James W. Breakey, John M. Freter, and Jack Wren 10-25(257)

A Kneeless Leg Prosthesis for the Elderly Amputee, Advanced Version: Rahamin Seliktar and R.M. Kenedi 10-25(97-119)
— Conclusions 10-25(114)
— Dynamic Analysis of Gait 10-25(115-119)
— The Evaluation Procedure 10-25(104-105)
— Equipment 10-25(104)

— Patients 10-25(104)
— Test Procedure 10-25(104-105)
— The Kneeless Concept 10-25(100-114)
— The Mechanisms of the Leg 10-25(100-103)
Knit-Rite Co.
— Stump Sock Compliance Testing, VAPC Research Report 10-23(260)
Koch, Richard F.
— Signal Compression and Expansion Apparatus with Means for Preserving or Varying Pitch. Recent Patents 10-30(291)
Kodak Ektalite Microfiche Reader, VAPC Research Report 10-25(143)
Kolenik, Steve A.
— Implantable Nerve Stimulator. Recent Patents 10-26(375)
Kollmorgen Corp., Glen Cove, New York
— Photocircuits Div., Printed-Armature "Pancake" Electric Motor for Wheelchairs, VAPC Research Report 10-25(147-148)
Konigsbert, Robert L.
— Myoelectrically Controlled Prosthesis. Recent Patents 10-27(209)
Konvalin, Robert L.
— Adjustable Leg Brace. Recent Patents 10-24(284)
— Konvalin Adjustable AFO and KAFO, VAPC Research Report, 10-23(225-226)
Kosiak, Michael
— Massaging Support Apparatus. Recent Patents 10-27(209)
Koslin, Bertram
— Prosthesis-to-Bone Interface System. Recent Patents 10-30(290)
Kraus, Werner
— Apparatus for Promoting Healing Processes. Recent Patents 10-25(257)
— Device for Promoting Formation of Bone Material. Recent Patents 10-26(375)
Kroes, William Jacobus
— Page Turning Device. Recent Patents 10-22(529)
Krouskop, Thomas A.
— Biomedical Engineer Honored by Texas Society. Notes and News 10-25(246)
— Cosmetic Covers for Lower-Limb Prostheses: T.A. Krouskop, P.H. Newell, Jr., and L.A. Leavitt 10-22(411-414)
Krusen Center for Research and Engineering, Moss Rehabilitation Hospital, Philadelphia, Pennsylvania
— Clinical Evaluation of A Sensory Feedback Device: the Limb Load Monitor 10-29(8-49)
Kuehnegger, Walter
— Orthopedic Brace (Orthosis). Recent Patents 10-27(209)

Kupfer, Carl
— Named Winner of 1976 Migel Medal. Notes and News 10-26(371)
Kurzweil Computer Products Co., Cambridge, Massachusetts 02142
see Kurzweil, Raymond C.
Kurzweil, Raymond C.
— *See* Kurzweil Reading Machine
Kurzweil Reading Machine
— A Description of the Kurzweil Reading Machine and a Status Report on its Testing and Dissemination: Aaron Kleiner and Raymond C. Kurzweil 10-27(72-81)
— Anti-Obsolescence Strategy 10-27(77-78)
— History and Current Status 10-27(78-81)
— NFB Participation in Development 10-27(80)
— Other Federal Programs 10-27(79-80)
— Preliminary Tests on Secondary School Children 10-27(81)
— Veterans Administration Program 10-27(79)
— Character Recognition 10-27(75-76)
— The Scanner 10-27(73-75)
— Speech Generation 10-27(76-77)
— User Controls 10-27(77)
Kurzweil Reading Machine *see also* Reading Machines

L

La Caron Industries, Kenilworth, New Jersey
— La Caron Lift Chair Model 76, VAPC Research Report 10-27(114-115) 10-28(120-121)
Lakeside Industries, Inc., Milwaukee, Wisconsin
— Lakematic Powered Wheelchair, VAPC Research Report 10-23(239-240)
La Marre, David A.
— Artificial Intraocular Lens. Recent Patents 10-30(287)
Lamers, David F.
— Auto-Monitoring Communication Devices for Handicapped Persons. Recent Patents 10-24(284)
Lamoreux, Larry
— Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion. Contractor Reports: C.W. Radcliffe, D.M. Cunningham, J.M. Morris, and L. Lamoreux (University of California, Berkeley, Calif.) 10-28(141-152) 10-29(120-122) 10-30(193-196)
Lanoue, Alcide M.

— Controlled Early Ambulation of Heel Surface Defects Covered by Pedicle Flaps in Lower-Limb Amputees: J.H. Herndon, A.M. Lanoue, and S.P. Frileck 10-21(9-22)
Lapidus, Roy
— Inflatable Device for Healing of Tissue. Recent Patents 10-26(375)
LAPOC Safety Knee (Compliance Testing)
— VAPC Research Report 10-28(129)
Laser Cane
— Bionic Laser Cane: Loyal E. Apple (Western Blind Rehabilitation Center) 10-22(458-459)
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: J.D. Malamazian, H. Lauer, and J.J. Whitehead (VA Hospital, Central Rehabilitation Section for Visually Impaired and Blinded Veterans, Hines, Illinois) 10-23(337-338) 10-24(264-265)
— Clinical Study of Mobility Aids for the Blind. Contractor Reports: John D. Malamazian, Leicester W. Farmer, and James J. Whitehead (Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois)
— Bionic Instruments, Inc., Laser Cane 10-27(189)
— Followup Site Visitation Program, Comment 10-26(352)
— Training with Laser Cane Suspended until Production is Resumed 10-29(169)
— Fabrication of Obstacle Detectors for the Blind. Contractor Reports: T.A. Benham, J.M. Benjamin, Jr., and R. Bolgiano (Bionic Instruments, Bala Cynwyd, Pa.) 10-21(151-153)
— Documentation 10-21(152)
— Outreach 10-21(152-153)
— Performance Testing 10-21(152)
— Public Exposure 10-21(151-152)
— Repair of C-4 Canes 10-21(151)
— The Laser Cane: J. Malvern Benjamin, Jr. 10-22(443-450)
— Laser Cane Blind Mobility Aid. Contractor Reports: J.M. Benjamin, Jr., N.A. Ali, and D.R. Bolgiano (Bionic Instruments, Inc., Bala Cynwyd, Pa.) 10-23(330-331) 10-24(256 no report) 10-25(215 no report)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Laser Canes and Other Aids Using Optical Principles
— C-2, C-3, C-4, C-5 Laser Canes 10-30(90-95)
— Cranberg Principle of Optical Triangulation 10-30(91-95)
— Laser Hazard 10-30(95-96)
— Training 10-30(91, 96)
— Mobility and Reading Aids for the Blind, Centrally Directed Clin-

ical Application Program. Contractor Reports: L.E. Apple, R. Bennett, W. Ekstrom, and D.C. Cooper (VA Hospital, Western Blind Rehabilitation Center, Palo Alto, California) 10-21(163-165)
— A Preliminary Followup Study of Electronic Travel Aid Users: Nancy C. Darling, Gregory L. Goodrich, and J. Kenneth Wiley. Western Blind Rehabilitation Center 10-27(82-91)
Laser Hazard
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Laser Canes and Other Aids Using Optical Principles 10-30(87-98)
Laser Typhlocane
— Mobility Aids for the Blind: Howard Freiberger 10-22(75)
Latta, Loren
— Development of Refined Fitting Procedures for Lower-Limb Prosthesis—Case Studies of Applied Research in Orthotics and Prosthetics. Contractor Reports: Augusto Sarmiento, Newton C. McCollough, and Loren L. Latta (University of Miami, Miami, Florida) 10-24(234-235) 10-25(204) 10-26(317) Fred R. Hampton 10-28(162-178)
Latin American Association for Rehabilitative Medicine (AMLAR)
— Calendar of Events 10-29(203) 10-30(301)
Latin American Rehabilitation Conferences
— Notes and News 10-24(277)
Lauer, Harvey L.
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: J.D. Malamazian, H. Lauer, and J.J. Whitehead (Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Ill.) 10-23(337-338) 10-24(264-265)
— Clinical Trials of Reading Machines for the Blind. Contractor Reports: J.D. Malamazian, and H.L. Lauer (VA Hospital, Hines, Ill.) 10-21(161-162) 10-23(338-339) 10-24(265-266) 10-25(221-222) 10-26(353-354) 10-27(190-191) 10-28(229-230) 10-29(170-171) 10-30(270-271)
— Current State of the Research Effort at Veterans Administration Hospital, Hines, Illinois: J.D. Malamazian and H. Lauer 10-22(451-457)
— Reading Aids for the Blind: H.L. Lauer 10-22(64-72)
Leavitt, Lewis A.
— Cosmetic Covers for Lower-Limb Prostheses: T.A. Krouskop, P.H. Newell, Jr., and L.A. Leavitt 10-22(411-414)
— Development and Evaluation of Advanced Automotive Adaptive Equipment. Contractor Reports: Make McDermott, Jr., and

Lewis A. Leavitt (Texas A&M University, College Station, Texas) 10-25(205-206) 10-26(317-320) 10-27(149-154)
— The Improvement of Assistance Systems Through Research, Design, Clinical Testing, and Team Evaluation. Contractor Reports: Paul H. Newell, Jr., and Lewis A. Leavitt (Texas A&M University, College Station, Texas) 10-21(138-139) 10-23(312)
— The Improvement of Prosthetic and Orthotic Devices Through Materials Research, Analysis, Design, Clinical Testing, and Team Evaluation. Contractor Reports: Make McDermott, Jr., and L.A. Leavitt (Texas A&M University, College Station, Texas) 10-24(235-236)
— Safety During Mobility: M. McDermott, Jr., P.H. Newell, Jr., and L.A. Leavitt 10-22(388-390)
Lee, Bok Y.
— Clinical and Physiological Evaluation of Seat Cushions for the Paralyzed. Contractor Reports: Bok Y. Lee (VA Hospital, Castle Point, N.Y.) and Leon Bennett (VA Prosthetics Center, New York, N.Y.) 10-29(160-161) 10-30(258)
— Hemodynamic Evaluation of Postoperative and Preoperative Amputees. Contractor Reports: B.Y. Lee, F.S. Trainor, J.L. Madden, and E. Ejercito (VA Hospital, Castle Point, N.Y.) 10-21(142-143) 10-23(318-319) 10-24(239-241) D. Kavner 10-25(210-211) 10-26(322-323) 10-27(158-161) 10-28(180-181) 10-29(125-127) 10-30(199-200)
— Hemodynamic Evaluation in Selection of Amputation Level: B.Y. Lee 10-22(85-104)
Leg Prosthesis With Resiliently Mounted Stump Socket
— Recent Patents:Theodor Trumpler 10-21(178)
Leg *see also* Lower Limb
LEM Power Chair
— VAPC Research Report 10-28(114-115) 10-30(126-127)
Lentini, Richard
— Transcutaneous Nerve Stimulation for Treatment of Pain in Spinal-Cord-Injured Patients: R. Davis and R. Lentini 10-22(298-301)
Lesioning
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Lesioning (How Electrodes Produce Lesions) 10-23(97-106)
— Electrolytic Lesions 10-23(99-103)
— Radio Frequency Lesions 10-23(103-106)
Levitt, Andrea
— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: F.S. Cooper, J.H. Gaitenby, F. Ingemann, A.

Levitt, I. Mattingly, P.W. Nye, and L. Shockey (Haskins Laboratories, Inc., New Haven, Conn.) 10-28(225-228) 10-29(173-178) 10-30(273-275)
LEVO Stand-Up Wheelchair
— VAPC Research Report 10-30(127-130)
Lewis, Chester
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: G.M. Gillispie, W. De l'Aune, P. Gadbaw, and C. Lewis (Eastern Blind Rehabilitation Center, VA Hospital, West Haven, Conn.) 10-21(170-173) 10-23(348-351) 10-24(271-274)
Lewis, David W.
— A Device Designed to Approximate Shear Forces on Human Skin (A Preliminary Study): W.B. Nourse and D.W. Lewis 10-30(36-46)
— Edge Light: A New Approach to Studying the Microvascularization of the Skin: J.F. Kissinger, P.J. Verhonick, and D.W. Lewis 10-29(65-78)
— Spinal Column Prosthesis/Orthosis. Recent Patents 10-30(291)
— Thermographical Investigation of Decubitus Ulcers: R.S. Trandel, D.W. Lewis, and P.J. Verhonick 10-24(137-155)
Lewis, Earl A.
— Editorial—The First Ten Years—An Index: E.A. Lewis 10-21(1-2)
— Clinicial Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: E.A. Lewis, C.R. Sheredos, T.T. Sowell, and V.L. Houston 10-24(51-136)
Lewis, Gilbert W.
— Subminiature Insertable Force Transducer. Recent Patents 10-26(376)
Lexicon, Inc.
— Varispeech Machine. Contractor Reports: J.D. Malamazian and H. Lauer (Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois) 10-21(162) 10-30(271)
Liberman, A.M.
— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: F.S. Cooper, A.M. Liberman, J.H. Gaitenby, I.G. Mattingly, P.W. Nye, and G.W. Sholes (Haskins Laboratories, Inc., New Haven, Conn.) 10-23(331-335) 10-24(256-261) 10-25(216-218)
Liberson Electrical Stimulation
— VAPC Research Report 10-27(115-116)

Library of Congress
— Prepared a Braille Version of the Booklet "The American Economic System and Your Part in It." Notes and News 10-27(203)
Lifeline Systems, Inc., Newton Centre, Mass.
— Lifeline Home Emergency Alarm System, VAPC Research Report 10-27(101)
Lift Device
— Recent Patents: John H. Fowler, Jr. 10-21(178)
The Lift Lock: A Device to Increase the Lifting Ability of Dual-Control Prostheses: Lawrence E. Carlson and Dudley S. Childress 10-23(158-168)
— Dual Control 10-23(159-162)
— The Lift-Lock Concept 10-23(164-167)
— Capstan Principle 10-23(164-166)
— Final Design 10-23(166-167)
— Previous Solutions 10-23(162-163)
— Alternative Harness Patterns 10-23(162)
— Northrop Concept 10-23(163)
— Results of Patient Fitting 10-23(167)
Lifts and Transfer Aids
— Duphar Life Lift, Patient Lift and Stretcher, VAPC Research Report 10-27(113-114)
— The Mobilizer Powered Patient Transfer Device, VAPC Research Report 10-27(111-112)
— Reyer Lift, Wilch Manufacturing, Inc., Topeka, Kansas, VAPC Research Report 10-25(153)
Lifts and Transfer Aids
— *see also* Automotive Adaptive Equipment
— *see also* VAPC Research Report—Spinal Cord Injury Rehabilitation — Beds, Lifts, and Transfer Aids
Light Probes
— Mobility Device: Leicester W. Farmer 10-30(47-118)
— Other Electronic Devices and Systems 10-30(102-108)
Lightweight Wheelchairs
— A-BEC Electric Wheelchair, VAPC Research Report 10-24(180-182)
Limb Load Monitor
— Clinical Evaluation of a Sensory Feedback Device: The Limb Load Monitor: Gunilla Wannstedt and R.L. Craik 10-29(8-49)
Lindsay Russell Pathsounders
— Mobility Aids for the Blind: Howard Freiberger 10-22(76-77)
— Mobility Devices: L.W. Farmer 10-30(47-118)
— The Lindsay Russell E Model Pathsounder 10-30(82-87)

Linear Power Assist Device
— Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior and Charles M. Scott 10-24(43-50)
Linkages
— Computer Optimization of Polycentric Prosthetic Knee Mechanisms: Douglas A. Hobson and L.E. Torfason 10-23(187-201)
— Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion. Contractor Reports: C.W. Radcliffe, D.M. Cunningham, J.M. Morris, and L. Lamoreux (University of California, Berkeley, Calif.)
— Four-Bar-Linkage Polycentric Pneumatic Knee 10-26(288-289) 10-27(132-133) 10-28(141) 10-29(120-121) 10-30(193)
— Six-Bar-Linkage Knee with Friction Swing Control 10-26(289-291) 10-27(133) 10-28(141-142) 10-29(121) 10-30(193)
Lipskin, Ronald
— Trends in Nonlicensed Mobility Aids: R. Lipskin 10-22(41-52)
L. Monti Enterprises, Inc., Niagara Falls, New York
— Manufacturer, Gyro Gym Therapeutic Exerciser, VAPC Research Report 10-26(262-263)
L'Nard Associates, Inc., Providence, Rhode Island
— Multi-Podus Therapeutic Foot and Leg Unit, VAPC Research Report 10-26(259-261)
— Sani-Comfo Arm Splint, VAPC Research Report 10-27(115) 10-30(142-143)
Litters
— Motorized Litters, VAPC Research Report 10-21(90-91)
Live Lift
— The Lift Lock: A Device to Increase the Lifting Ability of Dual-Control Prostheses: Lawrence E. Carlson and Dudley S. Childress 10-23(158-168)
— Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior and Charles M. Scott 10-24(43-50)
— Device Description 10-24(46-49)
Local Shear Force
— A Device Designed to Approximate Shear Forces On Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— Editor's Note 10-30(36-37)
Locomotion and Lower-Limb Prosthetics: Charles W. Radcliffe 10-22(167-187)
— Biomechanical Studies of Human Locomotion 10-22(168-183)
— Cyclic Event Markers 10-22(170-172)
— Data-Control Information 10-22(178-180)

— Forces and Moments in the Lower Limb 10-22(172-173)
— Gait Evaluation 10-22(181-183)
— Instrumented Walkway 10-22(168-170)
— Self-Aligning Goniometry 10-22(173-177)
— Engineering-Design and Prototype Testing of Lower Limb Prosthetic and Orthotic Devices 10-22(184-185)
— Tube Couplings for Modular Prostheses 10-22(185)
— UC-BL Four-Bar Polycentric Pneumatic Knee 10-22(184)
— UC-BL Shank Axial-Rotation Device 10-22(184)
— UC-BL Six-Bar Linkage Knee—Disarticulation Prosthesis 10-22(184-185)
— Evaluation and Further Development of New Designs for Back Braces 10-22(185-187)
— Studies of Spinal Supports 10-22(185-187)
— Variable-Height-Powered Wheelchair 10-22(187)
Locomotion (Perceptual/Visual Aspects)
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Size-Shape Changes in Locomotion 10-26(72)
Locomotion *see also* Gait, Human Locomotion, Ambulation, Mobility
Logarithmic Inputs
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Data Treatment and Analysis 10-30(13-19)
The Long Cane
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Support or Orthopedic Canes and Crutches 10-30(56-70)
— Advantages 10-30(57)
— A Preliminary Followup Study of Electronic Travel Aid Users: N.C. Darling, G.L. Goodrich, and J.K. Wiley 10-27(82-91)
Long, Ivan A.
— Lower Limb Prosthesis. Recent Patents 10-23(359)
Long, Richard L.
— Lower Limb Prosthesis. Recent Patents 10-23(359)
Long-Term Muscle Recordings (Prosthetic Devices)
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Recording Electrodes 10-23(106-143)
— Long-Term Muscle Recordings (Prosthetic Devices) 10-23(133-138)
Lontz, John F.
— Current Status — Prosthetic Materials for Maxillofacial Reconstruction: J.W. Schweiger and J.F. Lontz 10-22(408-409)

— The First International Symposium on Facial Prosthetics, Arnhem, The Netherlands: J.F. Lontz 10-25(129-133)
— Honorary Fellow of American Academy of Maxillofacial Prosthetics. Notes and News 10-30(284-285)
— Maxillofacial Restorative Biomaterials and Techniques. Contractor Reports: J.W. Schweiger, and J.F. Lontz (Temple University School of Dentistry, Phila., Pa.) 10-21(143-145) 10-23(319-321) 10-24(241-243) 10-25(210-211) 10-26(323-330) 10-27(161-165) 10-28(182-188) 10-29(145-155) 10-30(223-244)

Louchek Cane
— Glowing Cane for the Night Traveler. Notes and News 10-28(246-247)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— High-Visibility Canes 10-30(55-56)

Loveless, John H.
— Prosthetic Joint Lock and Cable Mechanism. Recent Patents 10-30(290)

Lower-Limb Amputation
— The Importance of Amputation-Level Determination. Guest Editorial: Wesley S. Moore 10-28(1-3)
— Surgery as Related to Prosthetics and Orthotics: Ernest M. Burgess 10-22(15-21)

Lower-Limb Amputees
— Ambulation Training
— Clinical Evaluation of a Sensory Feedback Device: The Limb Load Monitor 10-29(8-49)
— *See also* Moore Load Cell
— Controlled Early Ambulation of Heel Surface Defects Covered by Pedicle Flaps in Lower-Limb Amputees: James H. Herndon, Alcide M. LaNoue, and Stanley P. Frileck 10-21(9-22)
— Immediate Postoperative Prostheses Research Study. Contractor Reports: Ernest M. Burgess (Prosthetics Research Study, Seattle, Washington)
— Amputation Surgery and Amputee Rehabilitation 10-23(290-292)
— Amputee Discussion Groups 10-27(138)
— Functional and Stress Analysis of Lower Limb Amputees Performing Extra-Ambulatory Activities 10-27(141-142) 10-28(155)
— Functional Capabilities Study 10-26(304) 10-27(138) 10-28(156)
— A Survey of Lower-Limb Amputes: Prostheses, Phantom Sensations, and Psychosocial Aspects: Bernice Kegel, Margaret L. Carpenter, and Ernest M. Burgess 10-27(43-60)

— Discussion 10-27(56-58)
— Introduction 10-27(43)
— Materials and Methods of the Survey 10-27(44)
— References 10-27(60)
— Results 10-27(44-60)
— Patient Sample 10-27(44-46)
— Prosthetic Information 10-27(46-53)
— Psychosocial Aspects of Amputation 10-27(53-56)
Lower-Limb Orthoses
— Development of Refined Fitting Procedures for Lower-Limb Prostheses—Case Studies of Applied Research in Orthotics and Prosthetics. Contractor Reports: A. Sarmiento, N.C. McCollough III, W.F. Sinclair (University of Miami School of Medicine, Miami, Florida) 10-21(136-137) 10-23(310-311) L. Latta 10-24(234-235) 10-25(204) 10-26(317) F.R. Hampton 10-28(162-178, A Final Report)
— Development of Refined Fitting Procedures for Lower-Limb Prostheses: Augusto Sarmiento
— Polypropylene Orthoses 10-22(121-125)
— Glancy, John, Developer of Lightweight Transverse Rotator for Lower-Limb Orthoses, VAPC Research Report 10-28(96)
— Orthotics Workshop. E.E. Harris
— Ankle-Foot Orthoses (AFO's) 10-22(499)
— Foot Orthoses (FO's) 10-22(499)
— Hip-Knee-Ankle Orthoses (HKAO's) 10-22(500)
— Knee-Ankle Orthoses (KAO's) 10-22(500)
— Knee Orthoses (KO's) 10-22(500)
— Orthotics: Gustav Rubin and Malcolm Dixon 10-22(26-31)
— Shoe-Sole Transverse Rotator Evaluated, VAPC Research Report 10-29(81-82)
— Surgery as Related to Prosthetics and Orthotics: Ernest M. Burgess 10-22(15-21)
Lower-Limb Prostheses
— Cosmetic Covers for Lower-Limb Prostheses: Charles W. Radcliffe 10-22(415-416)
— Cosmetic Covers for Lower-Limb Prostheses: Hans A. Mauch 10-22(410)
— Cosmetic Covers for Lower-Limb Prostheses: Thomas A. Krouskop, Paul H. Newell, Jr., and Lewis A. Leavitt 10-22(411-414)
— Development of Refined Fitting Procedures for Lower-Limb Prostheses: Augusto Sarmiento 10-22(114-132)
— Development of Refined Fitting Procedures for Lower-Limb Prostheses—Case Studies of Applied Research in Orthotics and Prosthetics. Contractor Reports: A. Sarmiento, N.C. McCollough

— Computer-Aided Control 10-22(220-223)
— Implementable Microcomputer 10-22(223-224)
— Toward Clinical Application 10-22(224-225)

III, W.F. Sinclair (University of Miami School of Medicine, Miami, Florida) 10-21(136-137) 10-23(310-311) L. Latta 10-24(234-235) 10-25(204) 10-26(317) F.R. Hampton 10-28(162-178, A Final Report)
— Nitschke-Tindall Ankle Rotator, VAPC Research Report 10-28(94-95)
Lower-Limb Prostheses
— *see also* Below-Knee Prostheses, Lower-Limb Prosthetics
Lower-Limb Prosthesis
— Recent Patents: Ivan A. Long and Richard L. Long 10-23(359)
Lower-Limb Prosthetics
— Design of Lower Limb Prosthetic and Orthotic Devices. Contractor Reports: Charles W. Radcliffe, Don M. Cunningham, James M. Morris, and Larry Lamoreux (University of California, Berkeley, California)
— Friction Stabilized Knee 10-26(292-293) 10-27(133) 10-28(142-144) 10-29(121) 10-30(193)
— Internal-Expanding Foot-to-Pylon Coupling 10-25(195)
— Modular Pylon Structure for Below-Knee Prostheses 10-28(146)
— Multi-Input Control and Knee Stability 10-28(148) 10-29(121-122) 10-30(194-195)
— SACH Foot With Metal Keel 10-25(195) 10-26(291-292) 10-27(133) 10-28(142-144) 10-29(121) 10-30(194)
— Shank Torque Absorber 10-21(124)
— Tube Couplings for Modular Prostheses 10-21(124-125) 10-23(286) 10-27(133) 10-28(144-146)
— UC-BL Four-Bar Polycentric Knee 10-21(194-195) 10-23(285) 10-24(221) 10-25(194-195) 10-26(288-289) 10-27(132-133) 10-28(141) 10-29(120-121) 10-30(193)
— UC-BL Shank Axial-Rotation Device 10-23(285-286) 10-24(221) 10-25(195) 10-28(148-151)
— UC-BL Six-Bar Linkage Knee Disarticulation Prosthesis 10-21(125-126) 10-23(286) 10-24(221) 10-25(195-196) 10-26(289-290) 10-27(133) 10-28(141) 10-29(121) 10-30(193)
— The Development of Artificial Limbs for Lower Limbs: Hans A. Mauch 10-22(158-166)
— Engineering-Design and Prototype Testing of Lower Limb Prosthetic and Orthotic Device: Charles W. Radcliffe 10-22(184-185)
— Tube Couplings for Modular Prostheses 10-22(185)
— UC-BL Four-Bar Polycentric Pneumatic Knee 10-22(184)
— UC-BL Shank Axial Rotation Device 10-22(184)
— UC-BL Six-Bar Linkage Knee-Disarticulation Prosthesis 10-22(184-185)

— Control of an Artificial Limb with Several Degrees of Freedom of Motion 10-27(129-132) 10-28(139-140)
— Experimental Multi-Input Computer-Controlled Knee Pros-

— Lower-Limb Prosthetics Workshop: Douglas A. Hobson 10-22(490-495)
— Research and Development in the Field of Artificial Limbs. Contractor Reports: Hans A. Mauch (Mauch Laboratories)
— Costmetic Foot-Shank Transition 10-23(280) 10-24(217) 10-25(179)
— Foot Attachment 10-24(217) 10-25(179) 10-26(273-274)
— Hydraulic Ankle Control System 10-27(121-122) 10-28(132-133) 10-29(117-118)
— Hydraulic Knee Control System for Geriatric Amputees 10-27(122-123) 10-28(134)
— Hydraulic System 10-21(181-121) 10-23(279-281) 10-24(214-216) 10-25(179-182) 10-26(273-275) 10-27(121-126) 10-28(132-134)
— New Three-Part Knee Bolt Design 10-26(274-275) 10-27(123-126) 10-29(120)
— Shank Attachment 10-24(216) 10-25(179) 10-26(274)
— S-N-S System 10-21(118-119) 10-23(279-280) 10-24(214-215) 10-27(122) 10-29(119-120)
— Surgery as Related to Prosthetics and Orthotics: Ernest M. Burgess 10-22(15-21)
— VA Prosthetics Center Research, Development, and Evaluation Program: Edward Peizer
— Composite Endoskeletal Structures 10-22(470)
— Graphite Fiber Composite Keel for SACH Feet 10-22(470-471)
— Machine Forming Plastic Sockets 10-22(471)
— UC-BL Four-Bar Linkage Polycentric Knee 10-22(470)
— UC-BL Shank Torque Absorber 10-22(470)
— VAPC Above-Knee Endoskeletal Structures 10-22(469)
— Weber-Watkins Rotator for Lower-Limb Prostheses 10-22(470)
Lower-Limb Prosthetics Workshop: Douglas A. Hobson 10-22(490-495)
— Above-Knee Prostheses 10-22(493-494)
— Components 10-22(493)
— Suspension and Cosmesis 10-22(493-494)
— Below-Knee Prostheses 10-22(492-493)
— Components 10-22(492)
— Cosmesis 10-22(492-493)
— Socket Design 10-22(492)
— Suspension 10-22(492)
— Feet and Ankles 10-22(491)
— Articulated Ankles 10-22(491)
— SACH Foot 10-22(491)
— General Recommendations 10-22(494-495)
— Biomechanical Studies 10-22(494)

Index

— Laboratory Development 10-29(131-132)
— Operation of the System 10-28(215-216) 10-29(130-131)
— Patient Evaluation 10-28(218) 10-29(132) 10-30(202-203)
— Stimulator Development 10-29(130) 10-30(202)

— Evaluation 10-22(494)
— Evaluation of Patients with Peripheral Vascular Disease 10-22(494-495)
— Standards 10-22 (494)
— Hip Disarticulation 10-22(494)
— Introduction 10-22(490)
— Knee Disarticulation 10-22(493)
— Partial Foot 10-22(490)
— Syme 10-22(490-491)
Lower-Limb Prosthetics
— *see also* Above Knee Prostheses, Artificial Limbs, Below-Knee Prostheses
— *see also* VAPC Research Reports — Prosthetics-Lower Limb
— *see also* VAPC Research Reports — Testing (Compliance)
Lower-Limb Torque Absorbers
— VAPC Research Report 10-24(198-199) 10-25(171) 10-26(264)
Lowman, Charles LeRoy, M.D. 1879-1977
— Biography of. Notes and News 10-28(255-256)
Low Vision
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Evaluation of Distance Vision with Optical Aids 10-26(93-101)
— Assessment of Skills through Criterion Exercises 10-26(99-100)
— *Behavioral Assessment of Visual Skills 10-26(100-101)*
— The Development of an Evaluation Procedure 10-26(95-96)
— Existing Bases for Developing a Model Evaluation Procedure 10-26(96-97)
— Intermediate Goal A: Maintenance of Personal Safety 10-26(97)
— Intermediate Goal B: Maintenance of Efficient Progress 10-26(97-98)
— Intermediate Goal C: Maintaining Acceptable Levels of Psychological Stress 10-26(98-99)
— Optical Aids and Mobility 10-26(93-95)
— Performance Over Trial Routes 10-26(97-99)
— Evaluation of Visual Function 10-26(50-59)
— Role of Peripheral Stimulation 10-26(51)
— Two Modes of Processing Visual Information 10-26(51-58)
— Contrast Sensitivity 10-26(54)
— Intermediate Dark-Focus 10-26(55-56)
— Luminance 10-26(53-54)
— Perceptual Learning and Visual Training 10-26(57-58)
— Refractive Error 10-26(54-55)
— Relationship to Vestibular-Optical Reflexes 10-26(56)

Bulletin of Prosthetics Research — Spring 1979

— Recent Patents: Joost Robert deWijn 10-30(290)
Mobile Bed/Chair for High Level Quadriplegics
— Contractor Reports: Jacquelin Perry and James R. Allen. The Professional Staff Association of the Rancho Los Amigos Hospital

— The Low Vision Person — "A Marginal Man" 10-26(102-117)
— Part 1—Psychological Aspects of Low Vision 10-26(102-110)
— Common Characteristics of Low Vision 10-26(103-108)
— Definition 10-26(102-103)
— General Comments 10-26(103)
— Introduction 10-26(102)
— Personal Adjustment Problems 10-26(106-108)
— Social Adjustment Problems 10-26(108-110)
— Part 2 — The Role of the Rehabilitation Specialist — Emphasize the Positive 10-26(110-117)
— Guidelines for the Low Vision Person 10-26(113-114)
— Guidelines for Working with Families 10-26(114-116)
— Summary of Conference Recommendations 10-26(118-125)
— Visual Training with Optical Aids: One Facet of Low Vision Service 10-26(75-92)
— Part One: Establishing a Low Vision Perspective 10-26(75-80)
— Approaches to Resolution of Life Problems 10-26(76-78)
— Conditions Imposed by Diminished Visual Perception 10-26(76)
— The Individual in Society 10-26(75-76)
— Need of a Team Approach to Low Vision Services 10-26(78-80)
— Supportive Services 10-26(80)
— Part Two: Low Vision Mobility with Optical Aids 10-26(80-92)
— Adaptive Training with Distant Low Vision Aids 10-26(88-90)
— Clinical Low Vision Examination 10-26(81-82)
— Comments on Durability of Distance Aids 10-26(88)
— Duration of Lessons and Length of Training 10-26(90)
— Followup 10-26(90)
— General Guidelines for Distance Vision Aids Training 10-26(83-88)
— Initial Orientation and Mobility Evaluation 10-26(80-81)
— Low Vision Clinic Policies Regarding Prescribing and Dispensing Low Vision Aids and Systems 10-26(82-83)
— Telescopic Low Vision Aids and Ambulation: Discussion 10-26(91)
— Understanding the Characteristics of the Distance Aid 10-26(84-88)
— Visual Training Without Aids 10-26(60-74)
— Detection and Processing of Information 10-26(63-67)
— Early-intervention Training Suggestions 10-26(67-69)
— Introduction 10-26(60)

— Electronic Mobility Aids 10-24(267) 10-25(224)
— Mobility Aids and Training 10-26(354) 10-28(232-233) 10-29(171-172)
— Current State of the Research Effort at Veterans Administration

— Motion Pictures 10-26(73-74)
— Training Suggestions for the Adventitiously Visually Impaired Person 10-26(70-74)
— Visual vs. Perceptual Problems 10-26(60-63)
Low Vision Aids
— Current State of the Research Effort at Veterans Administration Hospital, Hines, Illinois: John D. Malamazian and Harvey Lauer
— Low-Vision Program 10-22(454-457)
— Low Vision Aid Usefulness Related to Demographic, Psychological, and Medical Data in Computer Study. Contractor Reports: Eastern Blind Rehabilitation Center 10-26(360-361)
— Low Vision Aids and Training. Contractor Reports: Western Blind Rehabilitation Center 10-26(354-355)
Lozac'h, Yves
— New Head Control for Quadriplegic Patients: Y. Lozac'h, G. Gossalin, E.D. Sherman, and G. Gingras 10-23(151-157)
Lumbosacral Corset Material
— VAPC Research Report 10-23(260) 10-24(201)
Luminance
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Two Modes of Processing Visual Information 10-26(53-54)
Lyman Electric Co., Bridgeport, Conn.
— Adult Powered Tricycle, VAPC Research Report 10-28(113)
Lyman, John H.
— Editorial — The Wheel Keeps Turning: J. Lyman 10-24(1-2)
— Electrocutaneous Feedback for Artificial Limbs — Summary Progress Report, February 1, 1974, through July 31, 1975: R.E. Prior and J. Lyman 10-24(3-37)
— Fundamental and Applied Research Related to the Design and Development of Upper-Extremity Externally Powered Prostheses. Contractor Reports: J.H. Lyman, A. Freedy, and R. Prior (University of California, Los Angeles, Calif.) 10-21(122-123) 10-23(284-285) 10-24(219-220) 10-25(184-194) 10-26(286-288) M. Solomonow 10-27(129-132) 10-28(139-141) 10-29(104-106) 10-30(179-181)
— Studies Toward a Practical Computer-Aided Arm Prosthesis System: J. Lyman, A. Freedy, and M. Solomonow 10-22(213-225)
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand—Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case, and Charles M. Scott 10-26(170-191)
— Upper-Limb Prosthetics Workshop: J.H. Lyman 10-22(503-508)
— A Versatile Joint Rotation Device for Externally Energized Upper-Limb Prostheses: Paul Meadows and John Lyman 10-24(38-42)

— Light Probes 10-30(102)
— The Lindsay Russell E Model Pathsounder 10-30(82-84)
— The Mims Infrared Mobility Aid 10-30(105-106)
— Mowat Sonar Sensor 10-30(102-103)
— The Nottingham Obstacle Detector 10-30(104-105)

M

McCann Co., John D., Burlington, New Jersey
— Woolen Stump Socks, Compliance Testing, VAPC Research Report 10-25(172)
McCollough, Newton C.
— Development of Refined Fitting Procedures for Lower-Extremity Prosthesis. Contractor Reports: A. Sarmiento, N.C. McCollough, and W.F. Sinclair (University of Miami, Miami, Florida) 10-21(136-137) 10-23(310-311) L. Latta 10-24(234-235) 10-25(204) 10-26(317) 10-28(162-178)
McDermott, Make, Jr.
— Development and Evaluation of Advanced Automotive Adaptive Equipment. Contractor Reports: M. McDermott and L.A. Leavitt (Texas A&M University, College Station, Texas) 10-25(205-206) 10-26(317-320- 10-27(149-154)
— The Improvement of Prosthetic and Orthotic Devices Through Materials Research, Analysis, Design, Clinical Testing, and Team Evaluation. Contractor Reports: M. McDermott, and L.A. Leavitt (Texas A&M University, College Station, Texas) 10-24(235-236)
— Safety During Mobility: Make McDermott, Jr., Paul H. Newell, Jr., and Lewis A. Leavitt 10-22(388-390)
McDowell, Charles L.
— Immediate Postoperative Application of Upper-Extremity Orthoses. Contractor Reports: C.L. McDowell (VA Hospital, Richmond, Va.) 10-21(137-138) 10-23(311 no report)
— Immediate Postoperative Application of Upper-Limb Orthoses: C.L. McDowell 10-22(404-405)
McFadden, James T.
— Wheelchair-Mounted Control Apparatus. Recent Patents 10-27(210)
MacFarland, Douglas C.
— Selected as 1975 Migel Medal Winner. Notes and News 10-24(276-277)
McLaurin, Colin A.
— Biofeedback—Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
— Prosthetics, Orthotics, and Sensory Aids Research Services. Contractor Reports: C.A. McLaurin (CPRD, National Academy of Sciences, Wash., D.C.) 10-21(109-118) 10-23(267-279)
Madden, John L.
— Hemodynamic Evaluation of Postoperative and Preoperative Amputees. Contractor Reports: Bok Y. Lee, F.S. Trainor, J.L. Madden, and E. Ejercito (VA Hospital, Castle Point, N.Y.) 10-21(142-143) D. Kavner 10-25(210-211) 10-26(322-323) 10-

— Mobility Aids for the Physically Disabled. Contractor Reports: Charles W. Radcliffe, Donald M. Cunningham, James M. Morris, and Larry Lamoreux (University of California, Berkeley, California) 10-21(126) 10-23(289-290) 10-24(222) 10-25(198)

27(158-161) 10-29(125-127) 10-30(199-200)
Magnitude Control
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Data Treatment and Analysis 10-30(13-19)
Magnussen, Ian
— A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals using Microprocessors: D. Graupe, W.J. Monlux, A.A.M. Beex, I. Magnussen 10-27(4-16)
Mahler Canes
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Folding or Collapsible Canes; Types 10-30(51-54)
Main-Tainer Corp., Sheldon, Iowa
— Stand-Aid Portable Standing Frames, VAPC Research Report 10-30(133-136)
Malamazian, John D.
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: J.D. Malamazian, L.W. Farmer, and J.J. Whitehead (VA Hospital, Hines, Ill.) 10-21(160-161) H. Lauer 10-23(337-338) 10-24(264-265)
— Clinical Study of Mobility Aids for the Blind. Contractor Reports: J.D. Malamazian, L.W. Farmer, and J.J. Whitehead (VA Hospital, Hines, Ill.) 10-25(219-221) 10-26(350-352) 10-27(187-190) 10-28(230-232) 10-29(167-169) 10-30(268-270)
— Clinical Trials of Reading Machines for the Blind. Contractor Reports: J.D. Malamazian, and H.L. Lauer (VA Hospital, Hines, Ill.) 10-21(161-162) 10-23(338-339) 10-24(265-266) 10-25(221-222) 10-26(353-354) 10-27(190-191) 10-28(229-230) 10-29(170-171) 10-30(270-271)
— Current State of the Research Effort at Veterans Administration Hospital, Hines, Illinois: J.D. Malamazian and H. Lauer 10-22(451-457)
Maling, Reginald
— Conceived POSSUM Environmental Control, VAPC Research Report 10-24(171)
Mallow, William
— Permanently Attached Artificial Limbs. Contractor Reports: C.W. Hall, and W. Mallow (Southwest Research Institute, San Antonio, Texas) 10-28(188-191) 10-29(155-158) 10-30(245-248)
Mandibular Replacement
— The First International Symposium On Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)

Bulletin of Prosthetics Research — Spring 1979

— *See also* new title "Mobility Engineering for the Severely Handicapped" in BPR 10-28, 10-29, 10-30
Mobility Aids for the Severely Handicapped. A Status Report: Charles M. Scott and Ronald E. Prior 10-26(192-213)

Manipulator
— Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses. Contractor Reports: John H. Lyman, Amos Freedy, Ronald Prior, and Moshe Solomonow (University of Calif. Los Angeles)
— Effectiveness for Veteran Quadriplegics of Medical Manipulators and Design Specifications for Improved Control 10-28(140-141)
— Evaluation of Medical Manipulators 10-29(105-106) 10-30(180-181)
— The Johns Hopkins Manipulator-Plus-Worktable System 10-29(106)
— Rancho Los Amigos Remote Manipulator (Golden Arm) 10-29(105-106) 10-30(180)
— Telescoping Manipulator Models 10-29(106)
— Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prostheses and Orthoses. Contractor Reports: Woodrow Seamone, and Gerhard Schmeisser, Jr. (The Johns Hopkins University, Laurel, Maryland)
— Clinical Evaluation Testing of the Computer Controlled Powered Medical Manipulator 10-29(116-117)
— Computer-Aided Powered Medical Manipulator 10-28(157-161)
— Book/Magazine Programs 10-28(160)
— Kleenex Program 10-28(160-161)
— Self-Feeding Program 10-28(158-160)
— Telephone Program 10-28(158)
— Typewriter Program 10-28(160)
— Design Approach 10-23(303-306)
— An Effort to Make Self-Feeding Practical 10-26(314-315)
— Experimental Manipulator System Requirements 10-23(301-302)
— Manipulator Unit for VA Hospital, West Roxbury, Massachusetts 10-27(148)
— Model IA for VAPC Testing 10-26(315)
— New Clinical Observations on the Manipulator in Use 10-26(311-314)
— Powered Manipulator Design Improvements 10-29(114-116)
— Chin-Nudge Control 10-25(201)
— Eyeglass Control Mode 10-27(144-145)
— Microprocessor-Controlled Robotic Arm/Worktable System 10-30(188-191)
— Model Select/Program Select 10-29(114-116)
— New Control Mode Options 10-25(201) 10-26(308)

Mobility Engineering for the Severely Handicapped
— Contractor Reports: C.M. Scott and R.E. Prior. Mobility Engineering and Development (MED), Canoga Park, California 10-28(191-192) MED, Van Nuys, California 10-29(158, no re-

— New Terminal Device 10-27(144-145)
— Optional Reading Tray 10-25(202) 10-26(311)
— Optical Coupler 10-29(114)
— Self-Feeding Arrangement 10-27(145-146)
— Telephone Option 10-25(201) 10-26(311)
— Two-Length Mouth Stick 10-25(201-202) 10-26(311)
— Voice-Controlled Wheelchair with Manipulator is Product of VA-NASA-HEW Cooperation. Notes and News 10-26(367)
Mann, Robert W.
— Receives ASME Medal. Notes and News 10-28(251)
Mannard, Allan
— Implantable Neural Electrode. Recent Patents 10-28(258)
Mann's E-Z Way Chair Lift
— VAPC Research Report 10-28(124-125)
Manual Communications Module (MCM)
— VAPC Research Report 10-27(98)
Marchak, Frank J.
— Paper Money Identifier. Recent Patents 10-27(209)
Marino, A.A.
— Evaluation of Electrical Techniques for Stimulation of Hard Tissue Growth. Contractor Reports: R.O. Becker, J.A. Spadaro, and A.A. Marino (VA Hospital, Syracuse, N.Y.) 10-27(180-184) 10-28(224 no report) 10-29(133-136) 10-30(206-209)
Marsolais, E. Byron
— Engineering Applications in Orthotic and Prosthetic Treatment of Musculoskeletal Defects. Contractor Reports: E.B. Marsolais, A.H. Burstein, and E. Schulz (VA Hospital, Wade Park, Cleveland, Ohio) 10-26(341-344) 10-27(172-174) 10-28(195-214) 10-29(127-129) 10-30(201)
— In Vivo Loading on Knee Joint Replacement: A.H. Burstein, V.H. Frankel, and E.B. Marsolais 10-22(193-199)
Martin, Michael Joseph
— Speech Synthesizing Apparatus. Recent Patents 10-30(291)
Mason, Carl P.
— Electric Elbow. Recent Patents 10-27(208-209)
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: C.P. Mason 10-25(38-54)
Massaging Support Apparatus
— Recent Patents: Michael Kosiak 10-27(209)
Mattingly, Ignatius G.
— Research on Audible Ouputs of Reading Machines for the Blind. Contractor Reports: F.S. Cooper, J.H. Gaitenby, I.G. Mattingly, P.W. Nye, and G.N. Sholes (Haskins Laboratories, Inc., New Haven, Conn.) 10-21(153-158) A.M. Liberman 10-23(331-335) 10-24(256-261) 10-25(216-218) F. Ingemann, and L. Shockey

— Artificial Tendon 10-25(76-79)
— Intramedullary Rod Extension 10-25(72-74)
— Supracortical Extension 10-25(74-76)
Modular Prostheses

10-26(345-348) 10-27(185-187) 10-28(225-228) A. Levitt 10-29(173-178) 10-30(273-275)
Mattress for Preventing Bedsores
— Recent Patents: E. Allen Blair 10-25(259)
Mauch, Hans A.
— Cosmetic Covers for Lower-Limb Prostheses: H.A. Mauch 10-22(410)
— The Development of Artificial Limbs for Lower-Limbs: Hans A. Mauch 10-22(158-166)
— The Development and Evaluation of a Personal Reading Machine for the Blind. Contractor Reports: Hans A. Mauch, and Glendon C. Smith (Mauch Laboratories, Inc., Dayton, Ohio) 10-21(158-160)
— The Development of Personal Reading Machines for the Blind: Hans A. Mauch and Glendon C. Smith 10-22(427-432)
— Reading Aid for the Blind. Recent Patents 10-23(359)
— Reading Aid for the Blind. Recent Patents 10-26(376)
— Reading Machine Employing a Two-Dimensional Multiple Snapshot Process. Recent Patents 10-23(359)
— Reflex Viewer and Tracking Aid. Recent Patents 10-25(258)
— Research and Development in the Field of Artificial Limbs. Contractor Reports: H.A. Mauch (Mauch Laboratories, Inc., Dayton, Ohio) 10-21(118-121) 10-23(279-282) 10-24(214-217) 10-25(183-184) 10-26(273-275) 10-27(121-126) 10-28(132-134) 10-29(117-120) 10-30(193)
— Research and Development in the Field of Reading Machines for the Blind. Contractor Reports: H.A. Mauch, and G.C. Smith (Mauch Laboratories, Inc., Dayton, Ohio) 10-23(336-337) 10-24(261-264) 10-25(218-219) 10-26(348-350) 10-27(61-71 Report incorporated into article under same title) 10-28(228-229)
Mauch Knee Bolt
— VAPC Research Report 10-24(199)
Mauch Laboratories, Inc., Dayton, Ohio *see* Mauch, Hans A.
Maxillofacial Prosthetic Center, VA
— The First International Symposium On Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
Maxillofacial Reconstruction
— Current Status — Prosthetic Materials for Maxillofacial Reconstruction: James W. Schweiger and John F. Lontz 10-22(408-409)
Maxillofacial Restorative Biomaterials and Techniques
— Contractor Reports: James W. Schweiger, and John F. Lontz. Temple University School of Dentistry, Maxillofacial Research, Philadelphia, Pennsylvania 10-21(143-145) 10-23(319-321) 10-24(323-330) 10-25(241-243) 10-26(210-211) 10-27(161-165) 10-

— The Importance of Amputation-Level Determination. Guest Editorial: W.S. Moore 10-28(1-3)
— Skin Blood Flow and Healing: W.S. Moore 10-22(105-108)
More Concern for Needs of Physically Handicapped Likely in Interna-

28(182-188) 10-29(145-155) VA Hospital, Wilmington, Delaware 10-30(223-244)
— Adhesives 10-23(321) 10-26(328-329)
— Biomechanical Replication of Living Tissue (Tensile Characteristics) 10-26(324-325)
— Changes in Tactile Quality With Hygienic Cleaning 10-26(327)
— Changes in Tactile Quality With Temperature 10-26(325-326)
— Color Standardization 10-26(327-328)
— Colorants 10-23(320-321)
— Digital Color Difference Indices of Human Skin 10-27(162-163)
— Digital Color Different Measurements for Artificial Pigments 10-27(163-164)
— Economic and Practical Considerations 10-26(329-330)
— Investigation of Elastomers and Polymers for Compatibility with Maxillofacial Reconstructions, Part I. 10-21(143-144) Part II. 10-21(144-145)
— Phase VI — Production 10-30(224-244)
— Products Development 10-29(153-154)
— Safety and Performance of Maxillofacial Prostheses-Conformity With Medical Devices Act (1976) 10-29(145-153)
— Stability to Actinic Exposure 10-26(325-326)
— Toxicological Testing for Product and Process Certification 10-26(329)
Maxillofacial Restorative Materials and Techniques
— The First International Symposium On Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
May, Denis R. W.
— Alignment Device for Artificial Limbs. Recent Patents 10-29(195)
— Artificial Leg with Stable Link-Type Knee Joint. Recent Patents 10-23(358)
— Symes Ankle Joint. Recent Patents 10-24(286)
Meadows, Paul
— A Versatile Joint Rotation Device for Externally Energized Upper-Limb Prostheses: P. Meadows and J. Lyman 10-24(38-42)
Mecalift
— VAPC Research Report 10-26(256-257) 10-30(139-142)
Mecanaids, Inc., Gloucester, England
— Ambulift Patients Lift and Transfer Aid, (Illust.), VAPC Research Report 10-26(255-256) 10-30(137-139)
— Autolift Patient Bathtub Lift and Transfer Aid (Illust.), VAPC Research Report 10-26(255-256) 10-30(137-139)
— Mecalift, Patient Transfer Aid, VAPC Research Report 10-26(256-257)

Bulletin of Prosthetics Research — Spring 1979

Trauma. Contractor Reports: I. Perkash (VA Hospital, Palo Alto, California) and W. Motloch (Children's Hospital at Stanford University, Palo Alto, California) 10-30(258-260)
Motorette 24 Volt Power Package for Wheelchairs

— Mecalift Portable Patient Lift and Transfer Aid (Illust.), VAPC Research Report 10-30(139-142)
Mechanically Operated Voice Synthesizer (MOVS)
— VAPC Research Report 10-27(100-101)
Mechanical Prosthesis of the Knee
— Recent Patents: Mario C. Valenti and Jorge C. Samaranch 10-20(195)
Medical Appliance
— Recent Patents: George J. F. Sele 10-21(178)
Medical College of Virginia, Virginia Commonwealth University, Richmond, Virginia 23298
— *See* Jeanette F. Kissinger
Medical Equipment Distributors, Inc., Upper Darby, Pennsylvania
— Distributor Sip "N" Puff Dialer, VAPC Research Report 10-27(104-105)
— Zero-Pressure Remote Power Control, VAPC Research Report 10-26(223-224)
— Zero Pressure Telephone Dialer, VAPC Reseach Report 10-27(104)
Medical Methods, Bay St. Louis, Mississippi
— Duphar Life Lift 10-27(113-114) 10-30(133)
— Manufacturer, Sip "N" Puff Dialer, VAPC Research Report 10-27(104-105)
— Manufacturer, Zero Pressure Telephone Dialer, VAPC Research Report, 10-27(104)
— Zero-Pressure Remote Power Control, VAPC Research Report 10-26(223-224)
Mediterranean Conference on Medical and Biological Engineering
— 2nd Conference. Calendar of Events 10-30(301)
Medpro, Inc., East Brunswick, New Jersey
— Medpro Chair Flotation Cushion, VAPC Research Report 10-28(117)
Mehr, Edwin B.
— Experience with Closed Circuit Television in the Blind Rehabilitation Program of the Veterans Administration: E.B. Mehr, A.B. Frost, and L.E. Apple 10-21(54-68)
Mentor 401 Nerve Stimulator
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
— Mentor 401 10-25(44-45)
Mercy Lift
— VAPC Research Report 10-21(101-103)
Method and Apparatus for Programming a Computer Operated Robot Arm
— Recent Patents: Merton D. Corwin, Jr., Richard E. Hohn, and

— Biographical Note on Henry H. Kessler, M.D., Ph.D., 1896-1978. Notes and News 10-29(189-194)
— Biographical Note on Leo Harold Riley, M.D. 1919-1977. Notes and News 10-30(285-286)

Ronald L. Tarvin 10-26(376)
Method and Apparatus for Six-Degree-of-Freedom Force Sensing
— Recent Patents: Paul C. Watson and Samuel H. Drake 10-30(289)
Method of Making a Permanent Prosthetic Socket
— Recent Patents: Charles C. Asbelle, Michael F. Arrigo, and Gerald K. Porter 10-24(285)
Method of and Means for Adaptively Filtering Near-Stationary Noise from Speech
— Recent Patents: Daniel Graupe and G. Donald Causey 10-30(289)
Method and Means for Scrambling and Descrambling Speech at Audio Frequencies
— Recent Patents: Daniel Graupe and G. Donald Causey 10-30(289)
Method of Raised Xerographic Printing and Product
— Recent Patents: Ezekiel J. Jacob 10-25(257)
Methods for Investigating Internal Physiological Phenomena
— Recent Patents: Jean Duroux 10-30(289-290)
Method and System for Control of a Powered Prosthetic Device
— Recent Patents: Edmund B. Weis, Jr., Craig R. Hassler, and John H. Flora 10-26(376)
M. E. W. Co., Tulsa, Okla.
— Mann's E-Z Way Chair Lift for Wheelchairs, VAPC Research Report 10-28(124)
Meyer, Paul R.
— The Spinal-Cord-Injured Patient Workshop: P.R. Meyer 10-22(513-516)
Microcomputer-Aided Prostheses
— Control of an Artificial Upper Limb in Several Degrees of Freedom. Contractor Reports: D. Graupe (Colorado State University, Fort Collins, Colorado) 10-21(139-141) 10-23(312-315) 10-24(236-238) 10-25(206-207) 10-26(320-322) 10-27(155-157) 10-28(178-179) 10-29(107-108) 10-30(182-183)
— Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses. Contractor Reports: John H. Lyman, Amos Freedy, Ronald Prior, (University of California, Los Angeles) 10-21(122-123) 10-23(284-285) 10-24(219-220) 10-25(184-194) 10-26(286-288) Moshe Solomonow 10-27(129-132) 10-28(139-141)
— Microcomputer Control System 10-26(286-287) 10-27(130-131) 10-28(139-140)
— The VA/UCLA Four-Degrees-of-Freedom Arm with Computer-Aided Control and Pattern-Recognition 10-25 (188-193)
— Studies Toward a Practical Computer-Aided Arm Prosthesis System: John Lyman, Amos Freedy, and Moshe Solomonow 10-22(213-225)

and Anthony M. Dymond 10-23(51-150)
— Muscle Stimulation 10-23(91-92)
— *See also* Functional Electrical Stimulation
Muscle Synergy Patterns

— Computer-Aided Control 10-22(220-223)
— Implementable Microcomputer 10-22(223-224)
— Toward Clinical Application 10-22(224-225)
Microfiche Reader
— VAPC Breath-Operated Microfiche Reader 10-20(294-295)
— VAPC Research Report 10-21(91-92) 10-25(143-144)
Microfilm Reader
— VAPC Research Report 10-26(224-225)
Microlert Corp., North Hollywood, California
— Microlert Electronic Alert System, VAPC Research Report 10-27(105)
— Microlert System for the Home, VAPC Research Report 10-30(125)
Microprocessor Control Systems for Prostheses
— Control of an Artificial Upper Limb in Several Degrees of Freedom. Contractor Reports: D. Graupe. Colorado State University, Department of Electrical Engineering, Fort Collins, Colorado 10-21(139-141) 10-23(312-315) 10-24(236-238) 10-25(206-207) 10-26(320-322) 10-27(155-157) 10-28(178-179) 10-29(107-108) 10-30(182-183)
— Analytical Work 10-30(183)
— Changing Microprocessor Identification to Four-Parameter Autoregressive Model Form 10-28(179)
— Equipment Modification 10-30(183)
— Modified Myoelectric System 10-25(207)
— Papers Presented 10-25(207)
— Preliminary Clinical Study 10-30(182-183)
— Control of Upper Limb Prostheses in Several Degrees of Freedom: Daniel Graupe 10-22(226-236)
— Conclusions 10-22(231-232)
— EMG-Actuated Subsystem 10-22(228-231)
— Toe-Actuated Control 10-22(227-228)
— Engineering Applications in Orthotic and Prosthetic Treatment of Musculoskeletal Defects. Contractor Reports: E.B. Marsolais, A.H. Burstein, E. Schulz. VA Hospital, Wade Park, Cleveland, Ohio 10-26(341-344) 10-27(172-174) 10-28(195-214) 10-29(127-129) 10-30(201)
— Functional Electrical Stimulation of the Muscles of the Hip 10-26(343-344) 10-27(173-174)
— Microprocessor-Based Stimulation System 10-29(128-129)
— Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses. Contractor Reports: John H. Lyman, Amos Freedy, Ronald Prior, and Moshe Solomonow (University of California, Los Angeles) 10-24(219) 10-26(286-288) 10-27(129-132) 10-28(139-140)

— UC-BL Shank Axial Rotation Device 10-22(184)
— UC-BL Six-Bar Linkage Knee-Disarticulation Prosthesis 10-22(184-185)

— Control of an Artificial Limb with Several Degrees of Freedom of Motion 10-27(129-132) 10-28(139-140)
— Experimental Multi-Input Computer-Controlled Knee Prosthesis 10-29(121-122) 10-30(194-195)
— Upper-Limb Prosthesis Project Using Microprocessor Hardware 10-29(105) 10-30(179)
— Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prostheses and Orthoses. Contractor Reports: W. Seamone and G. Schmeisser, Jr. The Johns Hopkins University, Applied Physics Laboratory, Silver Spring, Maryland 10-21(128-136) 10-23(300-310) 10-24(225-234) 10-25(200-203) 10-26(307-316) 10-27(142-149) 10-28(157-162) 10-29(109-117) 10-30(185-192)
— Advanced Powered Medical Manipulator With Microprocessor Control 10-27(147-148)
— Clinical Evaluation Testing of the Computer Controlled Powered Medical Manipulator 10-26(216)
— An Effort to Make Self-Feeding Practical 10-26(314-315)
— Microprocessor-Controlled Robotic Arm/Worktable System 10-30(188-191)
— New Clinical Observations on the Manipulator in Use 10-26(311-314)
— A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals Using Microprocessors: Daniel Graupe, Alosius A.M. Beex, William J. Monlux, and Ian Magnussen 10-27(4-16)
— Comparison of Method Using One-to-Three Electrodes with Other Methods Employing Large Numbers of Electrodes 10-27(5)
— Conclusions 10-27(15)
— Description of Hardware 10-27(11-13)
— Data Acquisition 10-27(12)
— Microprocessor Computing System 10-27(12-13)
— Prosthesis Interface 10-27(13)
— Function Discrimination Performance 10-27(14-15)
— Outline of the Function-Separation Algorithm 10-27(5-11)
— Control Aspects 10-27(11)
— Limb-Function Discrimination 10-27(8-11)
— Parameter Identification 10-27(6-8)
— Patient Evaluation of a Functional Electrical Stimulation Hand Orthosis. Contractor Reports: P.H. Peckham. VA Hospital, Wade Park, Cleveland, Ohio 10-26(344) 10-27(174-176) 10-28(214-218) 10-29(130-132) 10-30(201-203)
— Device Design and Fabrication 10-28(216-218) 10-29(130) 10-30(201)

— *Articulated Ankles 10-22(491)*
— SACH Foot 10-22(491)
— General Recommendations 10-22(494-495)
— Biomechanical Studies 10-22(494)

— Laboratory Development 10-29(131-132)
— Operation of the System 10-28(215-216) 10-29(130-131)
— Patient Evaluation 10-28(218) 10-29(132) 10-30(202-203)
— Stimulator Development 10-29(130) 10-30(202)
Microprocessor Control Systems for Wheelchairs
— Development of a Wheelchair Using a Myoelectric Control System. Contractor Reports: A.B. Rossier, M. Sarkarati, and G.E. Crawford (VA Hospital, West Roxbury, Massachusetts) 10-29(158-159) 10-30(255-257)
— Mobility Aids for the Severely Handicapped. Contractor Reports: C.M. Scott. Mobility Engineering and Development (MED), Playa Del Rey, California 10-23(327-328) 10-24(249-250) R.E. Prior 10-25(212) MED, Canoga Park, California 10-26(331, Report incorporated into article under same title, pp. 192-213) 10-27(168, Report for this period covered in article in 10-26, pp. 192-213) 10-28(191-192) 10-29(158, no report) 10-30(248-255)
— Microprocessor-Based Control System for Van-Compatible Wheelchair 10-30(249-255)
— Mobility Aids for the Severely Handicapped. A Status Report: Charles M. Scott and Ronald E. Prior 10-26(192-213)
— *Block Diagram for Van Control System* 10-26(208)
Microprocessor Hardware in Hearing-Aid System
— Development of a Hearing-Aid System With Independently Adjustable Subranges of its Spectrum Using Microprocessor Hardware. Contractor Reports: D. Graupe (Colorado State University, Fort Collins, Colorado) and G.D. Causey (University of Maryland, College Park, Maryland and VA Hospital, Washington, D.C.) 10-23(351-352) 10-24(274-275) 10-25(241-242) 10-26(363-364) 10-27(199-200) 10-28(241-242) 10-29(178-179) 10-30(275-276)
Miller, Curtis H.
— Transcutaneous Nerve Stimulator. Recent Patents 10-30(292)
Miller, William Wanet, III
— Head Actuated Control Apparatus for Battery-Powered Wheelchair. Recent Patents 10-30(288)
Milton Roy Co., St. Petersburg, Florida
— Royalaire Bed, VAPC Research Report 10-26(253-254)
The Mims Infared Mobility Aid
— Mobility Devices: Leicester W. Farmer 10-30(105-106)
Mims Seeing Aid
— Mobility Aids for the Blind: Howard Freiberger 10-22(77-78)
Minor, Orval L.
— Simplified Artificial Leg Structure with Articulated Knee Joint. Recent Patents 10-25(258)
Mixture for Anchoring Bone Implants

— Perceptual Learning and Visual Training 10-26(57-58)
— Refractive Error 10-26(54-55)
— Relationship to Vestibular-Optical Reflexes 10-26(56)

— Recent Patents: Joost Robert deWijn 10-30(290)
Mobile Bed/Chair for High Level Quadriplegics
— Contractor Reports: Jacquelin Perry and James R. Allen. The Professional Staff Association of the Rancho Los Amigos Hospital Downey, California 10-23(329 no report) 10-24(253 no report) 10-26(334-339 A Final Report)
— Background 10-26(334-335)
— Organization of the Project 10-26(335)
— Purpose 10-26(334)
Mobile Bed/Wheelchair Development: Jacquelin Perry and James Allen 10-22(370-376)
Mobility Aids for the Blind
— Clinical Application Study of Mobility Aids for the Blind. Contractor Reports: J.D. Malamazain, L.W. Farmer, and J.J. Whitehead (VA Hospital, Central Rehabilitation Section for Visually Impaired and Blinded Veterans, Hines, Illinois) 10-25(219) 10-26(350-352) 10-27(187-190) 10-28(230-232) 10-29(167-169) 10-30(268-270)
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: J.D. Malamazian, H. Lauer, and J.J. Whitehead (VA Hospital, Central Rehabilitation Section for Visually Impaired and Blinded Veterans, Hines, Illinois) 10-23(337-338) 10-24(264-265)
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: G.M. Gillispie, W. De l'Aune, P. Gadbaw, C. Lewis (VA Hospital, Eastern Blind Rehabilitation Center, West Haven, Connecticut) 10-21(170-173) 10-23(348-351) 10-24(271-274) 10-25(238-241) D. Garner 10-26(360-363) 10-27(196-198) 10-28(238-240) 10-29(164-167) 10-30(261-268)
— Orientation and Mobility Performance in the Blind 10-23(349)
— Parameters of Lateral Obstacle Detection 10-21(170-171) 10-23(248)
— Use of Prisms by Veterans with Visual Field Restrictions 10-23(349)
— The Value of Prisms 10-25(239)
— Visual and Auditory Impairment Simulation Development 10-23(261-262)
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, A. Wood (VA Hospital, Western Blind Rehabilitation Center, Palo Alto, California) 10-23(339-341) K. Wiley 10-24(267-268) 10-25(223-226) 10-26(354-357) 10-27(191, Report incorporated into article entitled "A Preliminary Followup Study of Electronic Travel Aid Users" pp. 82-91) S. Paul 10-29(171-173) 10-30(272-273)

— Detection and Processing of Information 10-26(65-67)
— Early-intervention Training Suggestions 10-26(67-69)
— Introduction 10-26(60)

— Electronic Mobility Aids 10-24(267) 10-25(224)
— Mobility Aids and Training 10-26(354) 10-28(232-233) 10-29(171-172)
— Current State of the Research Effort at Veterans Administration Hospital, Hines, Illinois: John D. Malamazian and Harvey Lauer
— Electronic Mobility Aids Program 10-22(453-454)
— Current State of the VA Research Effort at the Western Blind Rehabilitation Center: Loyal E. Apple
— Electronic Mobility Devices 10-22(458-459)
— Binaural Sensory Aid 10-22(459)
— Bionic Laser Cane 10-22(458-459)
— Evaluation Procedures for Environmental Sensing, Orientation and Mobility by the Blind. Contractor Reports: R.A. Weisgerber (American Institutes for Research) 10-25(233, 236-238)
— The Laser Cane: J. Malvern Benjamin, Jr. 10-22(443-450)
— Mobility Aids for the Blind: Howard Freiberger 10-22(73-78)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Binaural Sensory Aids (BSA) 10-30(98-102)
— Canes and Walking Aids 10-30(47-74)
— Folding or Collapsible Canes 10-30(50-54)
— High-Visibility Canes 10-30(55-56)
— The Long Cane 10-30(48-50)
— Support or Orthopedic Canes and Crutches 10-30(56-70)
— Walkers 10-30(70-74)
— Wheeled Canes 10-30(55)
— A Canterbury Child's Aid 10-30(108)
— Electronic Travel Aids (ETA's): History and Development 10-30(75-108)
— Benefits from ETA's 10-30(78)
— Experimental Devices 10-30(108-111)
— Electrocortical Prosthesis 10-30(108-109)
— The Tactile Vision Substitution System 10-30(109-111)
— The FOA Swedish Laser Cane 10-30(105)
— Laser Canes and Other Aids Using Optical Principles:
— C-4 Laser Cane Evaluation 10-30(90)
— C-5 Laser Cane Evaluation 10-30(91-95)
— Early Laser Canes 10-30(90)
— "Flashlight" Detector 10-30(89)
— The G-5 Obstacle Detector 10-30(89)
— The Laser Cane 10-30(87)
— Laser Hazard 10-30(95)
— Limitations 10-30(96)
— Training 10-30(96)
— Training, Evaluation, Evaluation and Followup 10-30(91)
— United States Signal Corps Obstacle Detector 10-30(87-88)

— A Versatile Joint Rotation Device for Externally Energized Upper-Limb Prostheses: Paul Meadows and John Lyman 10-24(38-42)

— Light Probes 10-30(102)
— The Lindsay Russell E Model Pathsounder 10-30(82-84)
— The Mims Infrared Mobility Aid 10-30(105-106)
— Mowat Sonar Sensor 10-30(102-103)
— The Nottingham Obstacle Detector 10-30(104-105)
— References 10-30(112-117)
— The Single Object Sensor (SOS) Bui Device 10-30(106-107)
— The SE Pathsounder 10-30(84-87)
— The Sonicguide 10-30(97)
— The Torch 10-30(97-98)
— A Preliminary Followup Study of Electronic Travel Aid Users: Nancy C. Darling, Gregory L. Goodrich, and J. Kenneth Wiley (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California)
— Family Opinion of ETA 10-27(85)
— Patterns of Use and Disuse 10-27(89-91)
— Recommendations 10-27(90-91)
— Travel Patterns with the Sonicguide and the Laser Cane 10-27(85)
— Reading and Mobility Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports J.D. Malamazian, L.W. Farmer, and J.J. Whitehead (Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois) 10-21(160-161)
— Research at the Eastern Blind Rehabilitation Center: George M. Gillispie and William De l'Aune 10-22(463-468)
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— *See* detailed listing at "Low Vision" entry of this article
Mobility Aids for the Blind: Howard Freiberger 10-22(73-78)
— Current State of the Art 10-22(74-78)
— Needs of the Veterans Administration 10-22(73-74)
Mobility Aids for the Physically Handicapped
— Adult Powered Tricycle, VAPC Research Report 10-28(113)
— Ausmus Moto-Stand, VAPC Research Report 10-28(114)
— Bed-Chair. Contractor Reports: J. Perry and J.R. Allen (The Professional Staff Association of the Rancho Los Amigos Hospital, Downey, California) 10-21(150)
— Driver Safety in Modified Vans: Charles M. Scott 10-22(377-387)
— Handicar TVE Battery-Powered Wheelchair-Carrying Vehicle (Illust.), VAPC Research Report 10-30(143-144)
— Mobile Bed/Chair for High Level Quadriplegics. Contractor Reports: J. Perry and J.R. Allen (The Professional Staff Association of the Rancho Los Amigos Hospital, Downey, California) 10-23(329 no report) 10-24(253 no report) 10-26(334-339 A Final Report)

— Mobility Aids for the Physically Disabled. Contractor Reports: Charles W. Radcliffe, Donald M. Cunningham, James M. Morris, and Larry Lamoreux (University of California, Berkeley, California) 10-21(126) 10-23(289-290) 10-24(222) 10-25(198) 10-26(294-295) 10-27(136) 10-28(151) 10-29(122) 10-30(195-196)
— Fabrication and Preliminary Test of PRAHN Wheelchairs 10-26(294)
— PRAHN (Powered, Reclining, Adjustable-Height and Narrowing) Wheelchairs 10-27(136) 10-28(151) 10-29(122) 10-30(195-196)
— Spring Suspension Bolt-on Powering Unit 10-26(294-295) 10-27(136) 10-28(151) 10-29(122)
— Urinal Bag 10-27(136) 10-28(151-152) 10-29(122)
— Parapodium for Adult Paraplegics: Martin T. Prast 10-22(391-403)
— Safety During Mobility: Make McDermott Jr., Paul H. Newell, Jr. and Lewis A. Leavitt 10-22(388-390)
— Special Vans Driven by Paralyzed Vets from N.Y. to Washington, D.C. Notes and News 10-22(522-524)
— Trends in Nonlicensed Mobility Aids: Ronald Lipskin 10-22(41-52)
— VAPC Powered Ambulator, VAPC Research Report 10-28(114-115)
— VA Prosthetics Center Program for Electric Wheelchairs and Other Non-licensed Mobility Aids: Ronald Lipskin 10-22(326-336)
— VA Prosthetics Center Research, Development, and Evaluation Program: Edward Peizer
— Adaptive Automotive Equipment Standards 10-22(474)
— Electro-Hydraulic Automotive Hand Control System 10-22(474)
— Hold Down System for Van Passenger in Wheelchair 10-22(474)
— Vans 10-22(474)
Mobility Aids for the Severely Handicapped
— Contractor Reports: C.M. Scott. (Mobility Engineering and Development (MED), Playa Del Rey, California) 10-23(327-328) 10-24(249-250) R.E. Prior 10-25(212) (MED, Canoga Park, California) 10-26(331, report incorporated into article under same title, pp. 192-213) 10-27(168, *see* article in 10-26(192-213)
— Base Unit 10-23(327)
— Electronic Van Control System 10-24(250)
— Joystick Controlled Chair-Van 10-25(212)
— Seat Design 10-23(327-328)
— Van Compatible Wheelchair 10-24(249-250) 10-25(212)

— *See also* new title "Mobility Engineering for the Severely Handicapped" in BPR 10-28, 10-29, 10-30
Mobility Aids for the Severely Handicapped. A Status Report: Charles M. Scott and Ronald E. Prior 10-26(192-213)
— Comprehensive Progress Report: High Reliability Chair-Van Systems for High Level Quadriplegic Patients. July 1, 1975 through September 30, 1976 10-26(206-213)
— Comprehensive Progress Report: The Mobility Van-Compatible Wheelchair. July 1, 1973 through September 30, 1976. 10-26(200-206)
— Description of the "Mobility 3000" Series Chair-Van Systems 10-26(193-197)
— Powered Wheelchair for the Independent Quadriplegic Patient 10-26(197-200)
— Background Discussion of Powered Wheelchairs 10-26(197-198)
— Design Criteria for Nonlicensed Mobility Aid (Wheelchair) 10-26(198-200)
Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Canes and Walking Aids 10-30(47-74)
— Folding and Collapsible Canes 10-30(50-54)
— Advantages and Disadvantages of Collapsible Canes 10-30(54-55)
— Specifications 10-30(50-51)
— Types 10-30(51-54)
— High-Visibility Canes 10-30(55-56)
— The Long Cane 10-30(48-50)
— Advantages 10-30(49-50)
— Disadvantages 10-30(50)
— Specifications 10-30(48-49)
— *See also* "Mobility Aids for the Blind" entry of this article for additional detailed listing including Electronic Travel Aids, etc.
Mobility and Reading Aids for the Blind, Centrally Directed Clinical Application Program
— Contractor Reports: L.E. Apple, R. Bennett, W. Ekstrom, and D.C. Cooper. VA Hospital, Western Blind Rehabilitation Center, Palo Alto, California 10-21(163-165)
Mobility Engineering and Development (MED), Canoga Park, California *see* Mobility Aids for the Severely Handicapped (Contractor Reports) also Mobility Aids for the Severely Handicapped—A Status Report: Charles M. Scott and Ronald E. Prior, also Mobility Engineering for the Severely Handicapped (Contractor Reports)
Mobility Engineering and Development, Playa Del Rey, California
— Passenger Safety in Vehicles for the Handicapped. Contractor Reports: C.M. Scott 10-21(145-146)

Mobility Engineering for the Severely Handicapped
— Contractor Reports: C.M. Scott and R.E. Prior. Mobility Engineering and Development (MED), Canoga Park, California 10-28(191-192) MED, Van Nuys, California 10-29(158, no report) 10-30(248-255)
— Electronically Controlled Van 10-28(192)
— Report of Progress 10-30(249-255)
— Evaluation of the High-Reliability Chair-Van System 10-30(255)
— High-Reliability Chair-Van Design and Development 10-30(254-255)
— Van-Compatible Wheelchair Design and Development 10-30(249-253)
— Van-Compatible Wheelchair Evaluation 10-28(191-192) 10-30(253-254)
— *See also* earlier title "Mobility Aids for the Severely Handicapped"
Mobility Research Conference, MIT
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Folding or Collapsible Canes Tentative Standards and Specifications 10-30(50-55)
Mobility Training
— A Preliminary Followup Study of Electronic Travel Aid Users: Nancy C. Darling, Gregory L. Goodrich, and J. Kenneth Wiley. Western Blind Rehabilitation Center. 10-27(82-91)
— *See also* Central Rehabilitation Section for Visually Impaired and Blinded Veterans, and Eastern Blind Rehabilitation Center
— *See also* Mobility Devices entry in "Mobility Aids for the Blind"
— *See also* Low Vision Workshop
Mobilizer (Powered Patient-Transfer Device)
— VAPC Research Report 10-21(100-101) 10-27(111-113)
Model
— Electrical Stimulation of Limbs: Part III. Joint Position Control: Alain Fournier, Etienne Dombre, and Philippe Coiffet 10-25(5-24)
— Model of Muscle Alone 10-25(14)
— Simulation of the Model 10-25(16-17)
— Identification of the Muscle Model 10-25(17)
— Identification of the Joint Model 10-25(17-18)
— Simulation of the Total Model 10-25(18-23)
Model Development
— Skeletal Extension Development: Criteria for Future Designs: Charles William Hall, P.A. Cox, and William A. Mallow 10-25(69-96)
— Model Development

— Artificial Tendon 10-25(76-79)
— Intramedullary Rod Extension 10-25(72-74)
— Supracortical Extension 10-25(74-76)
Modular Prostheses
— Design of Prosthetic and Orthotic Devices. Contractor Reports: Charles W. Radcliffe, Don M. Cunningham, and James M. Morris (University of Calif., Berkeley, California)
— Modular Pylon Structure for Below-Knee Prostheses 10-28(146)
— Tube Couplings for Modular Prostheses 10-21(124-125) 10-23(286) 10-27(133) 10-28(144-146)
— Tube Couplings for Modular Prostheses 10-22(185)
Monlux, William J.
— Control of an Artificial Upper Limb in Several Degrees of Freedom. Contractor Reports: D. Graupe, T.E. Kaplan, and W. Monlux (Colorado State University, Fort Collins, Colo.) 10-23(312-315)
— A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals Using Microprocessors: D. Graupe, A.A.M. Beex, W.J. Monlux, and I. Magnussen 10-27(4-16)
Montreal Head Control
— VAPC Research Report 10-24(182-183)
Moore, A. James, Jr.
— Moore Load Cell, VAPC Research Report, 10-23(222-223) 10-30(120)
— A Proposed Technique for the Postoperative Monitoring of Skin Tension in Below-Knee Amputees: Ernest M. Burgess, Craig A. Spolek, and A. James Moore, Jr. 10-28(4-15)
— A Study of Interface Pressures in the Below-Knee Prosthesis (Physiological Suspension) — an Interim Report: Ernest M. Burgess and A. James Moore 10-28(58-70)
Moore Load Cell for Lower-Limb Component Testing
— VAPC Research Report 10-23(222-223)
Moore, Robert R.
— Ankle Block. Recent Patents 10-24(375)
— Knee Brace. Recent Patents 10-23(358)
— Rotator for Prosthetic Ankle Joint. Recent Patents 10-26(376)
Moore, Wesley S.
— Below-Knee Amputation with Immediate Postoperative Fitting of Prosthesis. Contractor Reports: W.S. Moore, A.D. Hall, and L.A. Wilson (VA Hospital, San Francisco, Calif.) 10-21(128) 10-23(300) 10-24(225 no report) 10-25(200 no report) 10-26(307) 10-27(142 no report) 10-28(156 no report) (Tucson, Arizona) 10-29(124-125) 10-30(199)

— The Importance of Amputation-Level Determination. Guest Editorial: W.S. Moore 10-28(1-3)
— Skin Blood Flow and Healing: W.S. Moore 10-22(105-108)
More Concern for Needs of Physically Handicapped Likely in International Technical Standards
— Notes and News 10-28(250-251)
Morel, George
— Pneumatic Apparatus for Holding the Posture of Paralyzed, Diseased, Disabled or Wounded Persons. Recent Patents 10-23(359)
Moricca, Larry S.
— Polysensory Mobility Aid. Recent Patents 10-27(210)
Morin, Bernard
— Hand Control Apparatus for an Aircraft Usable by a Person Lacking Use of His Legs. Recent Patents 10-26(375)
Morris, James M.
— Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion. Contractor Reports: C.W. Radcliffe, H.D. Eberhart, D.M. Cunningham, and J.M. Morris (University of California, Berkeley, Calif.) 10-21(123-126) 10-23(285-290) 10-24(220-222) 10-25(194-198) 10-26(288-301) 10-27(132-136) 10-28(142-152) L. Lamoreux 10-29(120-122) 10-30(193-196)
Mortensen, La Vaughn L.
— Prosthetic Limb with Weight-Responsive Joint Lock. Recent Patents 10-26(376)
Mortensen Safety Knee
— VAPC Research Report 10-28(93-94)
Moser, Kurt
— Integral-Skin Cushion-Molding Apparatus. Recent Patents 10-30(289)
Moss Rehabilitation Hospital, Philadelphia, Pennsylvania
— Clinical Evaluation of a Sensory Feedback Device: The Limb Load Monitor: Gunilla Wannstedt and Rebecca L. Craik 10-29(8-49)
— Ultralight Below-Knee Prosthesis. Contractor Reports: A.B. Wilson 10-27(176-179) 10-28(218-219) 10-29(122-123) 10-30(196-197)
Motion Parallax
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Visual Training without Aids 10-26(60-74)
Motion Pictures as a Training Aid
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Motion Pictures 10-26(73-74)
Motloch, Wallace
— Seating Systems for Body Support and Prevention of Tissue

Research Report 10-26(255-256) 10-30(137-139)
— Mecalift, Patient Transfer Aid, VAPC Research Report 10-26(256-257)

Trauma. Contractor Reports: I. Perkash (VA Hospital, Palo Alto, California) and W. Motloch (Children's Hospital at Stanford University, Palo Alto, California) 10-30(258-260)
Motorette 24 Volt Power Package for Wheelchairs
— VAPC Research Report 10-21(99)
Motorized Litters
— VAPC Research Report 10-21(90-91)
Motorized Wheel Chair Drive
— Recent Patents: Ben J. Rosenthal 10-21(178)
Motorized Wheelchair
— Recent Patents: Donald Chisholm 10-22(528)
Mowat Sonar Sensor
— Evaluation of the Mowat Sonar Sensor: George M. Gillispie and William De l'Aune (Eastern Blind Rehabilitation Center) 10-22(465)
— Mobility Aids for the Blind: Howard Freiberger 10-22(77-78)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Other Electronic Devices and Systems 10-30(102-108)
Mross, Inc., Elizabeth, Colorado
— Tri-Pin Quad Steering Device, VAPC Research Report 10-26(259)
MSE Corp., Mountain View, California
— Manufacturer, Davis Suspension System for Wheelchairs, VAPC Research Report 10-26(242-243)
A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals Using Microprocessors: Daniel Graupe, Alosius A.M. Beex, William J. Monlux, and Ian Magnussen 10-27(4-16)
Multiplex Lower-Limb Prostheses
— VAPC Research Report 10-24(159-160)
Multiplex Mark II Above-Knee Prosthesis (Compliance Testing)
— VAPC Research Report 10-28(129-130)
Multiplex System
— Design Change, VAPC Research Report 10-26(217)
Multiplex Prosthesis *see also* VAPC Above-Knee
— Endoskeletal Prosthesis
Multi-Podus Therapeutic Foot and Leg Unit
— VAPC Research Report 10-26(259-261)
Murphy, Eugene F.
— Administrative Aspects of Contractual Research 10-22(487)
— Amputation Surgery and Prosthetics: E.F. Murphy 10-22(79-84)
— Biographical Note on Charles LeRoy Lowman, M.D., 1879-1977. Notes and News 10-28(255-256)
— Biographical Note on Gabriel Rosenkrantz, M.D. 1896-1975. Notes and News 10-25(253-256)

— Biographical Note on Henry H. Kessler, M.D., Ph.D., 1896-1978. Notes and News 10-29(189-194)
— Biographical Note on Leo Harold Riley, M.D. 1919-1977. Notes and News 10-30(285-286)
— Biographical Note on Tonnés Dennison, 1894-1976. Notes and News 10-28(251-253)
— Editor of Prosthetics: Highlights of Other VA Research Programs 10-21(109-150) 10-23(265-329) 10-24(209-256) 10-25(178-215) 10-26(272-344) 10-27(121-184) 10-28(132-224) 10-29(100-163) 10-30(176-260)
— Electrical Stimulation: E.F. Murphy 10-22(245-246)
— General Discussion and Closing Remarks (VA Research Conference): E.F. Murphy 10-22(517-520)
— New Materials: E.F. Murphy 10-22(406-407)
— Orthotics, Spinal Cord Injury, and Other Severe Disabilities: E.F. Murphy 10-22(295-297)
— Slipping Cane and Crutch Tips Part I — Static Performance of Current Devices: Eugene F. Murphy and Leon Bennett 10-28(71-90)
— Technology Transfer — Editorial: E.F. Murphy 10-29(1-7)

Murray, Mary Patricia
— Receives Federal Woman's Award. Notes and News 10-26(368-369)
— Studies of Normal and Abnormal Motion. Contractor Reports: M.P. Murray (VA Center, Wood, Wisconsin) 10-29(139-143) 10-30(216-217)

Muscle
— Electrical Stimulation of Limbs: Part III. Joint Position Control: Alain Fournier, Etienne Dombre, and Philippe Coiffet 10-25(5-24)
— Model of Muscle Alone 10-25(14)
— Identification of the Muscle Model 10-25(17)

Muscle Recording
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Muscle Recording 10-23(123-138)
— *See also* Electrodes, Myoelectric Control

Muscle Sites
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Data Treatment and Analysis 10-30(13-19)
— *See also* Myoelectric Control

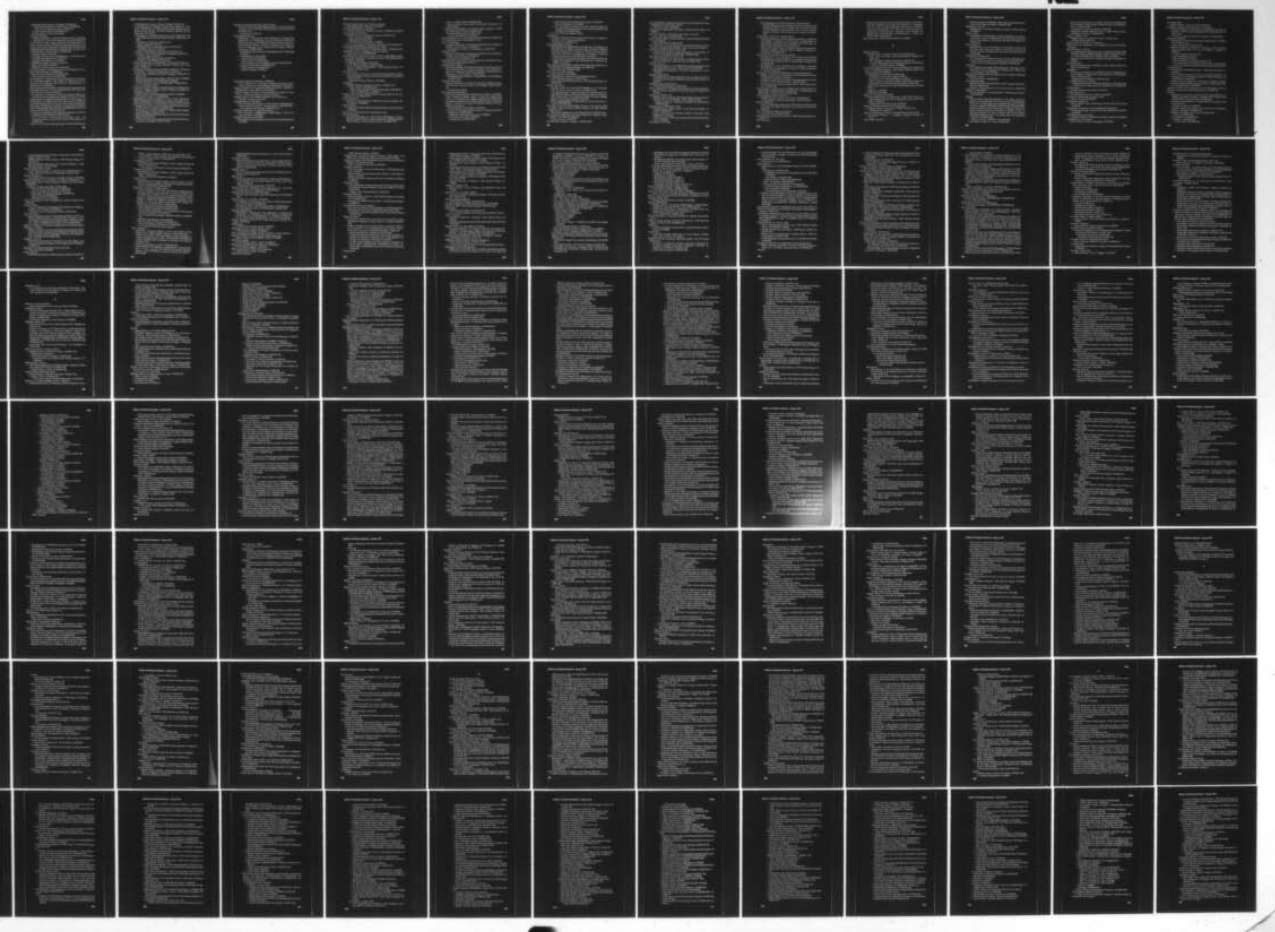
Muscle Stimulation
— Electrode Implantation in the Human Body: Margaret I. Babb

— Studies Toward a Practical Computer-Aided Arm Prosthesis System: John Lyman, Amos Freedy, and Moshe Solomonow 10-22(213-225)

and Anthony M. Dymond 10-23(51-150)
— Muscle Stimulation 10-23(91-92)
— *See also* Functional Electrical Stimulation
Muscle Synergy Patterns
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Data Treatment and Analysis 10-30(13-19)
Muscular Analysis of Lower-Limbs
— Electrophysiological Techniques in Evaluation and Correction of Neuro-muscular Defects. Contractor Reports: P.P. Griffin, R.G. Shiavi (VA Hospital, Nashville, Tennessee) 10-29(144-145) S. Champion, and F. Freeman 10-30(217-223)
— Studies of Normal and Abnormal Motion. Contractor Reports: M.P. Murray (VA Hospital, Wood, Wisconsin) 10-29(139-143) 10-30(216-217)
— *see also* Gait Analysis
Muscular Contraction
— Electrical Stimulation of Limbs: Pierre Rabischong, Francois Bonnel, Etienne Dombre, Edouard Peruchon, Philippe Coiffet, Blaine Fournier, and Jean-Marie Brebic 10-22(261-290)
— Part I — Basic Studies 10-22(261-290)
— Part II — Open Loop Control of Muscular Contraction 10-22(273-289)
Muscular Force
— Electrical Stimulation of Limbs: Part III. Joint Position Control: Alain Fournier, Etienne Dombre, and Philippe Coiffet 10-25(5-24)
— Characterization of the Muscular Force 10-25(13)
— Determination of the Muscular Force 10-25(11)
— *See also* Gait Analysis
Musculoskeletal Defects
— *see* Engineering Applications in Orthotic and Prosthetic Treatment of Musculoskeletal Defects
Myoelectrically Controlled Prosthesis
— Recent Patents: Charles H. Hoshall, Woodrow Seamone, and Robert L. Konigsberg 10-27(209)
Myoelectric Control
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, The VA Hand, and The VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
— Amputee and Clinic Team Reactions and Responses to the Experimental Devices 10-24(124-135)
— Amputee Reactions 10-24(124-125)

AD-A070 587 VETERANS ADMINISTRATION WASHINGTON DC DEPT OF MEDICI--ETC F/G 5/2
BULLETIN OF PROSTHETICS RESEARCH. SPRING 1979,(U)
1979 E F MURPHY
UNCLASSIFIED BPR-10-31 NL

5 OF 6
AD
A070587



— Description and Function of Systems 10-24(52-58)
— The VA/NU Myoelectric Hand System 10-24(56-58)
— The VA/NU Myoelectric Hand 10-24(132)
— Clinic Team Reactions 10-24(132-133)
— The Myoelectric Control 10-24(134)
— Results 10-24(75)
— Fitting Procedures: VA/NU Myoelectric System 10-24(76)
— Maintenance: The VA/NU Myoelectric Hand 10-24(96-103)
— Control of an Artificial Upper Limb in Several Degrees of Freedom. Contractor Reports: Daniel Graupe (Colorado State University, Fort Collins, Colorado) 10-21(139-141) 10-23(312-315) 10-24(236-238) 10-25(206-207) 10-26(320-322) 10-27(155-157) 10-28(178-179) 10-29(107-108) 10-30(182-183)
— Analytical Work 10-30(183)
— Changing Microprocessor Identification to Four-Parameter Autoregressive Model Form 10-28(179)
— Equipment Modification 10-30(183)
— Modified Myoelectric System 10-25(207)
— Papers Presented 10-25(207)
— Preliminary Clinical Study 10-30(182-183)
— Control of Upper Limb Prostheses in Several Degrees of Freedom: Daniel Graupe 10-22(226-236)
— EMG-Actuated Subsystem 10-22(228-231)
— Toe-Actuated Control 10-22(227-228)
— Development of a Wheelchair Using a Myoelectric Control System. Contractor Reports: A.B. Rossier, M. Sarkarati, and G.E. Crawford (VA Hospital, West Roxbury, Massachusetts) 10-29(158-159) 10-30(255-257)
— Electrocutaneous Feedback for Artificial Limbs. Summary Progress Report. February 1, 1974, through July 31, 1975: Ronald E. Prior and John Lyman 10-24(3-37)
— Investigation of Undesired Interaction between Myoelectric Control and Electrocutaneous Feedback 10-24(15-19, 20-21)
— Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses. Contractor Reports: John H. Lyman, Amos Freedy, Ronald Prior (University of California, Berkeley) 10-21(122-123) 10-23(284-285) 10-24(219-220) 10-25(184-194) 10-26(286-288) Moshe Solomonow 10-27(129-132) 10-28(139-141)
— Control of an Artificial Limb with Several Degrees of Freedom of Motion 10-27(129-130) 10-28(139-140)
— The VA/UCLA Four-Degree-of-Freedom Arm with Computer-Aided Control and Pattern Recognition 10-25(188-193)
— The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients

with Myoelectric Control: Hannes Schmidl 10-27(17-42)
— A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals Using Microprocessors: Daniel Graupe, Alosius A.M. Beex, William J. Monlux, and Ian Magnussen 10-27(4-16)
— Comparison of Method Using One-to-Three Electrodes with other Methods Employing Large Numbers of Electrodes 10-27(5)
— Description of Hardware 10-27(11-13)
— Data Acquisition 10-27(12)
— Microprocessor Computing System 10-27(12-13)
— Prosthesis Interface 10-27(13)
— Function Discrimination Performance 10-27(14-15)
— Outline of the Function-Separation Algorithm 10-27(5-11)
— Control Aspects 10-27(11)
— Limb-Function Discrimination 10-27(8-11)
— Parameter Identification 10-27(6-8)
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Prosthetics Research. Contractor Reports: Robert G. Thompson and Dudley S. Childress (Northwestern University)
— *Below-Elbow Myoelectric Fitting Techniques* 10-28(136) 10-29(101-102)
— Myoelectric System (Hook-Hand) 10-21(121-122) 10-23(282-284) 10-24(218-219) 10-25(183-184) 10-26(285)
— VA/NU Myoelectric Hand 10-23(282-284) 10-24(218-219)
— *See also* Synergetic Hook
— A Search for Better Limbs: Prosthetic Research at Northwestern University: Dudley S. Childress, John N. Billock, and Robert G. Thompson 10-22(200-212)
— Self-Contained and Self-Suspended Devices 10-22(204)
— Subconscious Control 10-22(202-204)
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand. Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case and Charles M. Scott 10-26(170-191)
— Design of Two, Three, and Four-Electrode SSF Systems for the VA/NU Myoelectric Hand 10-26(180-189)
— Performance of VA/NU Myoelectric Hand without Supplemental Feedback 10-26(175-178)
— Preliminary Design of SSF Systems for the VA/NU Myoelectric Hand 10-26(178-179)
— Undesired Interaction between Myoelectric Control and Electrocutaneous Feedback 10-26(173-175)

Myoelectric Proportional Pulse Control System
— New Head Control for Quadriplegic Patients: Yves Losac'h, Gilles Gossalin, E. David Sherman, Gustave Gingras, and Mary Ritchuk 10-23(151-157)
— Introduction 10-23(151)
Myofeedback Therapy
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
— Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects. Contractor Reports: P.P. Griffin, R. Shiavi, S. Champion, and F. Freeman (VA Hospital, Nashville, Tennessee) 10-30(217-223)
— Biofeedback (Myofeedback) in Rehabilitation for Hemiplegia 10-30(217)
— Methodology 10-30(218-220)
— Control Group 10-30(218)
— Data Analysis 10-30(219-220)
— Instrumented and Myofeedback Group 10-30(218-219)
— Results and Discussion 10-30(220-222)
— Muscle Control 10-30(220-221)
— Muscle Strength 10-30(222)

N

NASA Jet Propulsion Laboratory, California
— VAPC Contractor to Develop Wheelchair-Mounted Voice-Control System for VAPC-Designed Manipulator 10-24(208)
National Academy of Engineering Elects Howard D. Eberhart to Membership — Notes and News 10-27(204)
National Academy of Sciences, National Research Council *See* Committee on Prosthetics Research and Development
National Aids for the Disabled Exhibition and Conference
— Calendar of Events 10-21(186)
National Bureau of Standards
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Test and Selection Program 10-25(121-122)
National Conference on Aging and Blindness
— 2nd Conference: "Independence With Dignity: Action '78". Notes and News 10-28(246)
National Federation of the Blind
— Participation in Development of the Kurzweil Reading Machine 10-27(80)

National Handicrafters, Inc., Decatur, Georgia
— Wheelchair Shock Absorber 10-30(130)
National Rehabilitation Association
— Annual Conference. Calendar of Events 10-25(265) 10-29(201)
National Research Council
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Long Cane 10-30(48)
— Background 10-30(75-77)
— C-4 Laser Cane Evaluation 10-30(90)
— *See also* Committee on Prosthetics Research and Development
National Welded Products, Redwood City, Calif.
— National Indoor-Outdoor Wheelchair (Illust.) 10-28(109-110)
Nationwide Survey of Amputee Veterans Planned
— Notes and News 10-29(188-189)
Naval Electronics Laboratory Center, (N.E.L.C.), San Diego, California, VAPC Contractor to Develop an Electric Wheelchair-Stander 10-23(241) 10-24(208)
— VAPC Research Report 10-23(241)
— VAPC Research Report 10-24(184-185)
— N.E.L.C. Stand-Up Wheelchair. VAPC Research Report 10-24(185) 10-25(151-153)
Navy Fitch Arm
— The Lift Lock: A Device to Increase the Lifting Ability of Dual-Control Prostheses: Lawrence E. Carlson and Dudley S. Childress 10-23(158-168)
— Alternative Harness Patterns 10-23(162)
"Neckvibes"
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Types of ETA's 10-30(82-108)
— The Lindsay Russell E Model Pathsounder 10-30(82-84)
— Factory Modifications 10-30(84)
Needs of the Veterans Administration: Current State of the Art: Anthony Staros 10-22(13-14)
Neefe, Charles W.
— Bifocal Lens Which Positions Within the Anterior Chamber. Recent Patents 10-28(257)
Negi, Takafusi
— Auxiliary Ski for Physically Handicapped Persons. Recent Patents 10-23(358)
N.E.L.C. *see* Naval Electronics Laboratory Center
Nerve Stimulation
— Electrical Stimulation of Limbs: Pierre Rabischong, Francois Bonnel, Etienne Dombre, Edouard Peruchon, Philippe Coiffet, Blaine Fournier, and Jean-Marie Brebic 10-22(261-290)

— Part I — Basic Studies 10-22(261-273)
— Part II — Open Loop Control of Muscular Contraction 10-22(273-289)
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Stimulating Electrodes 10-23(62-106)
— Nerve Stimulation 10-23(89-91)
Nerve Stimulation *see also* Functional Electrical Stimulation (FES); also Transcutaneous Nerve Stimulation (TNS)
Nerve Transmission
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
— Characteristics of Nerve Transmissions 10-25(42-43)
Neuromod TNS
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
— Neuromod TNS 10-25(45, 47)
Neuromuscular Assist (NMA) *see* Neuromuscular Stimulation, Functional Electrical Stimulation (FES) etc.
Neuromuscular Defects
— Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects. Contractor Reports: P.P. Griffin, R.G. Shiavi (VA Hospital, Nashville, Tennessee) 10-29(144-145) S. Champion, and F. Freeman 10-30(217-223)
— Biofeedback (Myofeedback) in Rehabilitation for Hemiplegia 10-30(217-223)
Neuromuscular Loop
— Electrical Stimulation of Limbs: Part III. Joint Position Control: Alain Fournier, Etienne Dombre, and Philippe Coiffet 10-25(5-24)
— Introduction 10-25(5)
Neuromuscular Stimulation
— Functional Neuromuscular Stimulation of Limbs: A Feasibility Study. Contractor Reports: John A. Foster and Moshe Solomonow (VA Hospital, Los Angeles, California) 10-30(203-205)
— Immediate Postoperative Prostheses Research Study. Contractor Reports: Ernest M. Burgess (Prosthetics Research Study, Seattle, Washington)
— Neuromuscular Assist (NMA) 10-27(140)
— The Use of External Electrical Energy in Neuromuscular Rehabilitation 10-23(297-299)
— Miniature Implantable Electrodes 10-23(298)
— Neuromuscular Assist 10-23(297)
— Osteogenesis 10-23(297-298)

— Pain Abatement by Electrical Stimulation 10-23(297)
— Surface Stimulation 10-23(298)
— The Treatment of Scoliosis and Other Dynamic Spinal Deformities by Electrode Implantation and External Electrical Stimulation 10-23(298-299)
— *See also* Neurophysiological Studies
Neuropac II
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
— Neuropac II 10-25(46-47)
Neurophysiological Studies
— Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses. Contractor Reports: J.H. Lyman, A. Freedy, R. Prior, and M. Solomonow (University of California, Los Angeles, California)
— Electrotactile Sensory Aids 10-29(104) 10-30(179)
— Functional Neuromuscular Stimulation of Limbs 10-29(104-105)
— Upper-Limb Prosthesis Using Microprocessor Hardware 10-29(105) 10-30(179)
New Atlas of Orthotics Reflects Surge of Bioengineering Influences on Terminology, Prescription Methods, and Materials
— Notes and News 10-25(243-245)
New Centers for SCI Patients
— Notes and News 10-23(353)
New Ealing Reader (Automatic Scroll-Reading Device)
— VAPC Research Report 10-27(102-103)
— Now Called Saltus Reading System, VAPC Research Report 10-30(123-124)
Newell, Paul H., Jr.
— Cosmetic Covers for Lower-Limb Prostheses: T.A. Krouskop, P.H. Newell, Jr., and L.A. Leavitt 10-22(411-414)
— The Improvement of Assistive Systems through Research, Design, Clinical Testing, and Team Evaluation. Contractor Reports: P.H. Newell, and L.A. Leavitt (Texas A&M University, College Station, Texas) 10-21(138-139) 10-23(312)
— Safety During Mobility: M. McDermott, Jr., P.H. Newell, and L.A. Leavitt 10-22(388-390)
New Head Control for Quadriplegic Patients: Yves Losac'h, Gilles Gossalin, E. David Sherman, Gustave Gingras, and Mary Ritchuk 10-23(151-157)
— Wheelchair Adaptations and Training Period 10-23(153-154)
New "Journal of Blindness and Visual Impairment" Replaces AFB's "Outlook" and "Research Bulletin"
— Notes and News 10-26(373)
New Materials: Eugene F. Murphy 10-22(406-407)

New Rehabilitative Engineering Research and Development Center Established at VAH, Hines, Illinois
— Notes and News 10-28(244)
Newton Ultra Lightweight Wheelchair. VAPC Research Report 10-23(240)
New VA Amputee Treatment Center Opens in Denver
— Notes and News 10-22(521-522)
New York City's Department of Consumer Affairs Publishes a Booklet for the Disabled
— Notes and News 10-26(373-374)
New York State University Student Group Plans Graduate-Level Research on Programs for Disabled. Notes and News 10-25(252)
New York University, Bronx, New York
— Stump Stress Analysis. Contractor Reports: Leon Bennett 10-21(121) 10-23(282) 10-25(182-183) 10-26(275-285)
New York University, New York, N.Y.
— NYU Recognizes the Achievements of Sidney Fishman, Ph.D., and two Associates. Notes and News 10-25(247-248)
Nickel, Vernon L.
— Appointed Director of VA Rehabilitative Engineering Research and Development Service. Notes and News 10-28(243)
— Rehabilitative Engineering—A New Era—Editorial: V.L. Nickel 10-30(1-7)
Nissinen, Erkki Einari
— Straightening and Supporting Device for the Spinal Column in the Surgical Treatment of Scoliotic Diseases. Recent Patents 10-30(291)
Nitchke-Tindall Ankle Rotator
— VAPC Research Report 10-28(94-95)
Noise Compensation Techniques for Bioelectric Potential Sensing
— Recent Patents: Donald B. Everett and Louis W. Schlenz 10-26(376)
Nonlicensed Mobility Aid
— Mobility Aids for the Severely Handicapped. A Status Report: Charles M. Scott and Ronald E. Prior 10-26(192-213)
— Design Criteria for Nonlicensed Mobility Aid (Wheelchair) 10-26(198-200)
Northrop Corp., Hawthorne, Calif.
— Graphite-Epoxy Shank System, VAPC Research Report 10-21(72) 10-23(220-221)
— VAPC Contractor to Develop Graphite Composite Knee Mechanism 10-24(208)
— VAPC Contractor to Develop Graphite-Epoxy Endoskeletal Prosthesis 10-24(208)
Northwestern University

— VA/Northwestern (VA/NU) Myoelectric Hand Systems
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
Northwestern University, Chicago, Illinois
— Prosthetics Research. Contractor Reports: Robert G. Thompson and Dudley S. Childress 10-21(121-122) 10-23(282-284) 10-24(218-219) 10-25(183-184) 10-26(285) 10-27(127-129) 10-28(135-138) 10-29(100-103) 10-30(176-179)
— A Search for Better Limbs: Prosthetic Research at Northwestern University: Dudley S. Childress, John N. Billock, and Robert G. Thompson 10-22(200-212)
Northwestern University, Evanston, Illinois
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. Contractor Reports: R. Carhart and W.O. Olsen 10-21(165-166) 10-23(341-342) 10-24(268-269) 10-25(227-231) 10-26(356-357)
— Development of Test Procedures for Evaluation of Binaural Hearing Aids—A Final Report: Raymond T. Carhart and Lamar L. Young 10-26(9-45)
Northwestern University Rehabilitation Engineering Program
— Fidelity Comfort and Communication Control System (FCCS), VAPC Research Report 10-27(97)
— Northwestern University Comfort and Communications System (NUCCS). VAPC Research Report 10-23(242-243)
— Northwestern University Synergetic Hook. VAPC Research Report 10-28(95-96)
Notes and News 10-21(174-176) 10-22(521-527) 10-23(353-357) 10-24(276-283) 10-25(243-256) 10-26(365-374) 10-27(201-207) 10-28(243-256) 10-29(187-194) 10-30(280-286)
The Nottingham Obstacle Detector
— Mobility Devices: Leicester W. Farmer 10-30(104-105)
— Other Electronic Devices and Systems 10-30(102-108)
Nourse, William B.
— A Device Designed to Approximate Shear Forces on Human Skin (A Preliminary Study): David W. Lewis and W.B. Nourse 10-30(36-46)
Now, "Hearing-Ear Dogs" for the Deaf
— Notes and News 10-28(247-248)
Nu-Life Environmental Control System. VAPC Research Report 10-24(168-171)
Nye, Patrick W.

— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: F.S. Cooper, J.H. Gaitenby, I.G. Mattingly, P.W. Nye, and G.N. Sholes (Haskins Laboratories, New Haven, Conn.) 10-21(153-158) A.M. Liberman 10-23(331-335) 10-24(256-261) 10-25(216-218) F. Ingemann, and L. Shockey 10-26(344-348) 10-27(185-187) 10-28(225-228) A. Levitt 10-29(173-178) 10-30(273-275)
Nylon Knee Joint. VAPC Research Report 10-29(80)

O

Obstacle Detectors
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Laser Canes and Other Aids Using Optical Principles 10-30(87-108)
— The Nottingham Obstacle Detector 10-30(104-105)
— United States Signal Corps Obstacle Detector 10-30(87-88)
— The G-5 Obstacle Detector 10-30(89)
An Occipito-Zygomatic Cervical Orthosis Designed for Emergency Use — A Preliminary Report: Gustav Rubin, Malcolm Dixon, and Joel Bernknopf 10-29(50-64)
— Description of the Orthosis 10-29(51-58)
— Advantages of the New Design 10-29(57)
— Basic Features of Existing Orthoses 10-29(51)
— Basic Features of the New Design (Illustrated) 10-29(51-56)
— Retention of the SOMI Design Principles 10-29(57-58)
— Effect of the Orthosis on Cervical Motion (Illustrated) 10-29(59, 60-63)
— Indications 10-29(59)
— References 10-29(64)
Office of Naval Research (ONR)
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Background and Information 10-30(8-9)
Office of Scientific Research and Development
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Background 10-30(75-77)
Office of Technology Transfer: Principal Function Described
— Technology Transfer . . . an editorial: Eugene F. Murphy 10-29(1-7)
Ohio Willow Wood Co.

— Spring Controls for Multiplex Above-Knee Endoskeletal Structures, VAPC Research Report 10-26(217-218)
Ohlenbusch, Cord W.
— Bioelectrically Controlled Prosthetic Member. Recent Patents 10-24(284)
Oliver, Calvin
— Development and Evaluation of a New Artificial Larynx. Contractor Reports: Lewis P. Goldstein, Howard Rothman, and Calvin Oliver (VA Hospital, Gainesville, Florida) 10-29(186) 10-30(278-279)
Olsen, Wayne O.
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. Contractor Reports: Raymond Carhart, and Wayne O. Olsen (Northwestern University, Evanston, Ill.) 10-21(165-166)
On-the-Body Hearing Aid
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— New Two-Year Test Rotation Program 10-25(122-127)
Onyshko, S.
— A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W.R. Dyck, S. Onyshko, D.A. Hobson, D.A. Winter, and A.O. Quanbury 10-23(169-186)
Open House Celebrates the Opening of the New Western Blind Rehabilitation Center
— Notes and News 10-30(280-281)
The Ophthalmologist
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Need of a Team Approach to Low Vision Services 10-26(78-80)
Opponens Hand Splint
— Electric Opponens-Type Hand Splint, VAPC Research Report, 10-23(226-228)
Optacon
— Clinical Trials of Reading Machines for the Blind. Contractor Reports: J.D. Malamazian and H. Lauer (Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois) 10-21(162) 10-23(338-339) 10-24(265-266)
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, A. Wood, K. Wiley, and S. Paul (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California)
— Optacon 10-23(339-340)
— Optacon Activity 10-24(267) 10-25(223-224)
— The Optacon: Harvey L. Lauer 10-22(65-66)

— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Learning to Teach the Optacon 10-26(158)
— Telesensory Systems Optacon: Loyal E. Apple (Western Blind Rehabilitation Center) 10-22(460-461)
Optar, A "Passive" Aid
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Background 10-30(75-77)
Optical Character Reader *see* Cognodictor
Optical Character Recognition, *see* Cognodictor, Kurzweil Reading Machine
Optical Society of America
— Annual Meeting. Calendar of Events 10-22(537) 10-23(365, 366) 10-24(293, 294) 10-25(265, 266, 267) 10-26(385, 386) 10-27(216, 217, 218) 10-28(265, 266) 10-29(201, 202) 10-30(300)
— Spring Topical Conference. Calendar of Events 10-23(366) 10-24(293)
The Optometrist
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
Optophone
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Optophone Development 10-26(139-140)
— Mobility Devices: L. Farmer
— Background (D'Albe's Exploring Optophone, 1912) 10-30(75)
— Need of a Team Approach to Low Vision Services 10-26(78-80)
Orange, John I.
— Artificial Foot. Recent Patents 10-21(177)
Orthocasting System
— Recent Patents: Dennis N. Brown 10-27(209)
Orthomedics Fellowship Awarded at NYU
— Notes and News 10-27(206)
Orthopaedic Appliances
— Recent Patents: Pierre Rabischong and Jean Pierre Louis Bel 10-27(209)
Orthopaedic Associations of the English Speaking World
— Combined Meeting. Calendar of Events 10-22(538) 10-23(366) 10-24(293)
Orthopaedic Research Society
— Calendar of Events 10-23(365) 10-25(265) 10-27(217) 10-30(299)
Orthopedic Brace (Orthosis)
— Recent Patents: Walter Kuehnegger 10-27(209)

Orthopedic Heel
— Recent Patents: Thomas D. Hall 10-22(529)
Orthopedic Implant Device Retrieval and Analaysis
— Contractor Reports: A.M. Weinstein. VA Hospital, New Orleans, Louisiana 10-27(179-180) 10-28(219-224) 10-29(138-139) 10-30(215-216)
— Toward a Nationwide Retrieval Program 10-28(223-224)
Orthopedic Implants
— Developing a Permanently Attached Artificial Limb: C. William Hall 10-22(144-157)
— Bone Interfacing 10-22(153-156)
— Skeletal Extension Development: Criteria for Future Designs: Charles William Hall, P.A. Cox, and William A. Mallow 10-25(69-96)
— Tissue Interfacing 10-25(70-72)
— Skin Interfacing 10-25(70)
— Bone Interfacing 10-25(71)
— Musculotendinous Interfacing 10-25(71-72)
— *See also* Permanently Attached Artificial Limbs. Contractor Reports: C.W. Hall and W. Mallow (Southwest Research Institute)
Orthotic Devices
— Orthosis for Brachial Plexus Injury. VAPC Research Report 10-21(80-81)
— An Occipito-Zygomatic Cervical Orthosis Designed for Emergency Use—A Preliminary Report: G. Rubin, M. Dixon, and J. Bernknopf 10-29(50-64)
— Orthotic Transverse Rotator. VAPC Research Report 10-28(96)
— Pneumatic Powered Elbow Orthosis (Illust.), VAPC Research Report 10-26(218-219) 10-28(96-97)
Orthotic Devices *see also* Functional Electrical Stimulation, Orthotics
Orthotics: Gustav Rubin and Malcolm Dixon 10-22(26-36)
Orthotics
— Publications of Interest 10-21(181-182) 10-22(532-533) 10-23(362) 10-24(288) 10-25(261) 10-26(378-379) 10-27(211-212) 10-28(260-261) 10-29(197-198) 10-30(294-295)
— Orthotics and Rehabilitation Engineering for the Spinal Cord Injured Patient
— Calendar of Events 10-28(264)
— Orthotics, Spinal Cord Injury, and Other Severe Disabilities: Eugene F. Murphy 10-22(295-297)
— Orthotics Workshop: E.E. Harris 10-22(496-502)
— General 10-22(497-498)
— Introduction 10-22(496-497)
— Summary 10-22(498-502)
— Lower Limb 10-22(499-500)

— Spinal Orthoses 10-22(500-501)
— Upper Limb 10-22(501-502)
— *see also* Lower Limb Orthoses, Spinal Orthoses
Orthotics *see also* VAPC Research Reports—Development and Evaluation — Orthotics, VAPC Research Reports — Spinal Cord Injury Rehabilitation — Orthotics.
Otto Bock Orthopedic Industry
— SACH Feet Compliance Testing 10-23(258)
— The I.N.A.I.L. Experience with Myoelectric Control: H. Schmidl
— Pneumatic vs. Electric Prosthesis Power 10-27(20)
Over-the-Ear Hearing Aid
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— New Two-Year Test Rotation Program 10-25(122-127)
Owens, Lester J.
— Apparatus for Connecting a Prosthesis to a Bone. Recent Patents 10-26(375)

P

Pacini, Robert F.
— 1977 Recipient of Orthomedics Fellowship in Prosthetics and Orthotics. Notes and News 10-27(206)
PACO (Pivot Ambulating Crutchless Orthosis) *see* Prast, Martin T.
Page Scanners
— Kurzweil Computer Products Scanner Described 10-27(73-74)
— Page Scanners Compared with "Direct Translation" by Hand-Held Probe (Mauch Laboratories) 10-27(65-67)
Page Turning Device
— Recent Patents: William Jacobus Kroes 10-22(529)
Pain
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
Pak-A-Rak
— VAPC Research Report 10-30(144-145)
Palo Alto VA Blind Rehabilitation Center
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— C-4 Laser Cane Evaluation 10-30(90)
"Pancake" Motor *see* Powered Wheel
Panel on Hearing Aid Performance
— The Hearing-Aid Program of the Veterans Administration: Twenty Years of Service: G. Donald Causey 10-25(120-128)
— Introduction 10-25(120-121)
Pan Pacific Rehabilitation

— 5th Conference. Calendar of Events 10-22(537) 10-23(365)
— 6th Conference. Calender of Events 10-26(386) 10-27(218) 10-28(265) 10-29(202) 10-30(299)
Panzarella, Joseph J.
— Named "Handicapped American of the Year" by the President's Committee on Employment of the Handicapped. Notes and News 10-27(204)
Paper Money Identifier
— Recent Patents: Frank J. Marchak 10-27(209)
Parapodium for Adult Paraplegics *see* Prast, Martin T.
Paratrol MK. II
— VAPC Research Report 10-25(142)
Paralyzed Hospital-Director is Named "Handicapped American of the Year"
— Notes and News 10-27(204)
Paralyzed Veterans of America
— International Disabled Expo Calendar of Events 10-30(299)
— National Paraplegia Conference Calendar of Events 10-28(264)
Passenger Safety in Vehicles for the Handicapped
— Contractor Reports: C.M. Scott. Mobility Engineering and Development, Playa Del Rey, California 10-21(145-146)
— Driver's Seat Holding Device 10-21(146)
— Passenger-Chair Holding Device 10-21(146)
— Vehicle Driver's Seat Module 10-21(145)
Passive Aids (Electronic Travel Aids)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Electronic Travel Aids (ETA's): History and Development 10-30(75-108)
— Background 10-30(75-77)
Pathom Lucite Tube Cane
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— High-Visibility Canes 10-30(55-56)
Pathsounder
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Types of ETA's 10-30(82-108)
— The Lindsay Russell E Model Pathsounder 10-30(82-84)
— The SE Pathsounder and H Model 10-30(84-87)
— Training Methods 10-30(86-87)
Patient Evaluation of a Functional Electrical Stimulation Hand Orthosis
— Contractor Reports: P.H. Peckham. VA Hospital, Wade Park, Cleveland, Ohio 10-26(344) 10-27(174-176) 10-28(214-218) 10-29(130-132) 10-30(201-203)
Patient Lifts and Transfer Aids
— Ambulift (Illust.), VAPC Research Report 10-30(137-139)

— Autolift Patient Bathtub Lift and Transfer Aid, VAPC Research Report 10-30(137, 139)
— IMSECO Patient Transfer System, VAPC Research Report 10-24(193-194)
— Mecalift Portable Patient Lift and Transfer Aid (Illust.), VAPC Research Report 10-30(139-142)
Patient Profiles (Clinic Team)
— VAPC Research Report 10-25(173-174) 10-26(264-267) 10-27(119-120) 10-28(130-131) 10-29(98-99) 10-30(174-175)
Pattern Recognition
— International Joint Conference. Calendar of Events 10-25(265)
Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Design of Engineering Model 10-30(19-28)
— Control Circuit Characteristics 10-30(25-26)
— Data Treatment and Analysis 10-30(13-19)
— Electrodes and Electrode Support 10-30(23-25)
— Motor Control 10-30(26-27)
— Prehension Control 10-30(28)
Pattern Recognition *see also* Microprocessor Aided Prostheses and Orthoses
Pattern Theory
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
— Theories on the Transmission of Pain 10-25(41-42)
Paul, H. Stanton
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: J. Kenneth Wiley, Gregory L. Goodrich, Richard R. Bennett, and H. Stanton Paul (VA Hospital, Palo Alto, Calif.) 10-28(232-235) 10-29(171-173) 10-30(272-273)
PCEH *see* President's Committee on Employment of the Handicapped
Peckham, P. Hunter
— Patient Evaluation of a Functional Electrical Stimulation Hand Orthosis. Contractor Reports: P.H. Peckham (VA Hospital, Wade Park, Cleveland, Ohio) 10-26(344) 10-27(174-176) 10-28(214-218) 10-29(130-132) 10-30(201-203)
Pedegana, Larry R.
— Controlled Environment Treatment for Limb Surgery and Trauma (a Preliminary Report): E.M. Burgess and L.R. Pedegana 10-28(16-57)
Pedorthic Foot Symposium Held in New York City
— Notes and News 10-22(524)
Peizer, Edward
— VAPC Research Reports, Anthony Staros, Director, and Edward

Peizer, Assistant Director, BPR 10-21 through BPR 10-30
— VA Prosthetics Center Research, Development and Evaluation Program: Edward Peizer 10-22(469-477)
Perceptual Learning
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Perceptual Learning and Visual Training 10-26(57-58)
Peripheral Stimulation
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Role of Peripheral Stimulation 10-26(51)
Perkash, Inder
— Seating Systems for Body Support and Prevention of Tissue Trauma. Contractor Reports: I. Perkash (VA Hospital, Palo Alto, Calif.) 10-29(162-163) 10-30(258-260)
Permanently Attached Artificial Limbs
— Contractor Reports: C.W. Hall. (Southwestern Research Institute, San Antonio, Texas 10-21(145, no report) 10-23(321-327) 10-24(243-249) 10-25(211-212; for progress during this report period, *see* "Skeletal Extension Development: Criteria for Future Designs" 10-25(69-96) 10-26(331, for progress during ths report period, *see* 10-25, pp. 69-96) 10-27(165) also W. Mallow 10-28(188-191) 10-29(155-158) 10-30(245-248)
— Bone Interfacing Technique 10-23(323-324)
— Intramedullary Approaches 10-29(155-158)
— The Involuted Approach—A New Method for Percutaneous Skeletal Attachment 10-27(166-167)
— An Involuted Intramedullary Skeletal Extension 10-28(188-191)
— Materials and Methods 10-24(244-248)
— Skin Interfacing Techniques 10-23(322-323)
— Tendon Interfacing Techniques 10-23(324-326)
— *See also* Skeletal Extension Development)
Perry, Jacquelin
— Bed-Chair. Contractor Reports. J. Perry, and James R. Allen (Rancho Los Amigos Hospital, Downey, Calif.) 10-21(150)
— Clinical Gait Analyzer. Contractor Reports: J. Perry (Rancho Los Amigos Hospital, Downey, Calif.) 10-21(149-150) 10-23(329 no report) 10-24(251-253) 10-25(214) VA Rancho Gait Analyzer 10-26(331-333)
— Clinical Gait Analyzer: J. Perry 10-22(188-192)
— Mobile Bed/Chair for High Level Quadriplegics. Contractor Reports: J. Perry, and J.R. Allen (Rancho Los Amigos Hospital, Downey, Calif.) 10-23(329 no report) 10-24(253 no report) 10-26(334-339)

— Mobile Bed/Wheelchair Development: J. Perry and J. Allen 10-22(370-376)
Peruchon, Edouard
— Electrical Stimulation of Limbs: Part I—Basic Studies, Part II—Open Loop Control of Muscular Contraction: P. Rabischong, F. Bonnel, E. Dombre, E. Peruchon, P. Coiffet, B. Fournier, and J. Brebic 10-22(261-290)
Pfeiffer, Erich A.
— Device for Sensing and Warning of Excessive Ambulation Force. Recent Patents 10-21(177)
Philco-Ford
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Background and Information 10-30(8-9)
Photocircuits, (Div. Kollmorgen Corp.) Glen Cove, L.I., New York
— Printed Motors for Wheelchairs 10-26(229-232)
Photocurable Contour Conforming Splint
— Recent Patents: Donald C. Garwood and Harry Taw 10-29(195-196)
Physical Aids, Inc., El Cajon, California
— E-Z Patient Turning System, Inc., (Illust.), VAPC Research Report 10-28(118-119) 10-29(95-98)
— E-Z Reacher #201, VAPC Research Report 10-23(250-251)
— E-Z Tilt-a-Board Loader for Wheelchairs 10-28(122-123)
Physical Rehabilitation
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
— *See also* Biofeedback (Myofeedback); the Limb Load Monitor
Physical Response of SACH Feet Under Laboratory Testing: R.L. Daher 10-23(4-50)
Pihlaja, Eino
— Artificial Hand. Recent Patents 10-28(257)
Pilot Study of New Artificial Limb Contract
— VAPC Research Report 10-23(222)
Pivot Ambulating Crutchless Orthosis (PACO) *see* Prast, Martin T.
Pivoted Artificial Limb With Spring Loaded Joint Lock
— Recent Patents: Dennis William Collins 10-24(285)
Pivot Joint Adapter
— Recent Patents: Albert I. Weber 10-25(258)
Plantar and Dorsiflexion Foot Plates for Wheelchairs
— VAPC Research Report 10-28(114)
Plastic Knee Joint for Below-Knee Prosthesis
— VAPC Research Report 10-29(80)
Plastic Knee Orthosis

— VAPC Research Report 10-29(81)
Plexiglas Rigid Transparent Support Surface *see* Edge Light: a New Approach to Studying the Microvascularization of the Skin.
Pneumatic Apparatus for Holding the Posture of Paralyzed, Diseased, Disabled or Wounded Persons
— Recent Patents: George Morel 10-23(359)
Pneumatic Controls
— Hayes Pneumatic Control for Wheelchairs, VAPC Research Report, 10-21(97)
— Pneumatically Controlled Microfiche Reader, VAPC Research Report, 10-21(91)
— UC-BL Pneumatic Swing-Control Unit, VAPC Research Report 10-23(222)
Pneumatic Logic
— A Device Designed to Approximate Shear Forces On Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— Flapper Valve Physical Model 10-30(42-44)
Pneumatic Orthosis
— Functional Elbow Orthosis, VAPC Research Report 10-25(138-141) 10-26(218-219)
— Counter-Force Elbow Orthoses (Illust.), VAPC Research Report 10-28(96-97)
Pneumatically Powered Prostheses
— The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients With Myoelectric Control: Hannes Schmidl 10-27(17-42)
— Pneumatic vs. Electric Prosthesis Power (with Tabulated Data) 10-27(17-20)
Polycentric Knees
— Computer Optimization of Polycentric Prosthetic Knee Mechanisms: Douglas A. Hobson and L.E. Torfason 10-23(187-201)
— Design of Prosthetic and Orthotic Devices. Contractor Reports: C.W. Radcliffe, D.M. Cunningham, J.M. Morris, and L. Lamoreux (University of California, Berkeley, California)
— Knee Disarticulation Prosthesis 10-21(125-126)
— UC-BL Four-Bar Polycentric Knee 10-21(123) 10-22(184) 10-23(285) 10-24(221) 10-25(194-195) 10-26(288-289) 10-27(132-133) 10-28(141) 10-29(120) 10-30(193)
— UC-BL Six-Bar Linkage Knee Disarticulation Prosthesis 10-21(125-126) 10-22(184-185) 10-23(286) 10-24(221) 10-25(195-196) 10-26(289-290) 10-27(133) 10-28(141) 10-29(121) 10-30(193)
Polypropylene

— Polypropylene Fails as a Knee Joint Material for BK Prostheses, VAPC Research Report 10-29(80)
— Polypropylene Hip Joint and Pelvic Band, VAPC Research Report 10-25(136-137) 10-26(217) 10-27(94)
— Polypropylene Knee Orthosis, VAPC Research Report 10-25(138)
— Polypropylene Knee Orthosis as Prescribed for a Patient by VAPC Clinic Team, VAPC Research Report 10-25(175-176)
— Polypropylene Knee Orthosis with Suprapatellar Strap Suspension, VAPC Research Report 10-23(225)
— Vacuum-Forming of Ankle-Foot Orthoses, VAPC Research Report 10-21(77-79)
— Vacuum-Forming of Orthoses, VAPC Research Report 10-23(225)
Polysensory Mobility Aid
— Recent Patents: Larry S. Moricca, and Ronald H. Stroer 10-27(210)
Pope Brace Co., Kankakee, Illinois
— Vacuum-Forming of Ankle-Foot Orthoses, VAPC Research Report 10-21(77-79)
Portable Inflatable Bathtub
— VAPC Research Report 10-30(146-147)
Portable Telephones, VAPC Research Report 10-27(98-99)
Porta-Care Sink, VAPC Research Report 10-30(145-146)
PortaPrinter
— VAPC Research Report 10-25(144-145)
— *See also* Environmental Control and Communication Systems
Porter, Gerald K.
— Functional Ankle for a Prosthetic Limb. Recent Patents 10-29(195)
— Method of Making a Permanent Prosthetic Socket. Recent Patents 10-24(285)
Position Control of Above-Elbow Prostheses
— Contractor Reports: L.E. Carlson. University of Colorado, Department of Engineering Design and Economic Evaluation, Boulder, Colorado 10-29(108-109) 10-30(184-185)
Positive-Locking Knee/Shank Assemblies (Compliance Testing)
— VAPC Research Report 10-27(117)
POSSUM (Patient Operated Selector Mechanism)
— VAPC Research Report 10-24(171-173)
— *See also* Environmental Control and Communication Systems
Postsurgical Wound Management
— Below-Knee Amputation With Immediate Postoperative Fitting of Prosthesis. Contractor Reports: W.S. Moore, A.D. Hall, and

L.A. Wilson (VA Hospital, San Francisco, California) 10-21(128) 10-23(300) 10-24(225, no report) 10-25(200, no report) 10-26(307) 10-27(142, no report) 10-28(156, no report) (VA Hospital, Tucson, Arizona) 10-29(124-125) 10-30(109)
— CET *see* Controlled Environment Treatment (below)
— Controlled Early Ambulation of Heel Surface Defects Covered by Pedicle Flaps in Lower-Limb Amputees: James H. Herndon, Alcide M. LaNoue, and Stanley P. Frileck 10-21(9-22)
— Case Reports 10-21(12-18)
— Discussion 10-21(18-22)
— Method 10-21(10-12)
— Controlled Environment Treatment (CET) for Limb Surgery and Trauma (a Preliminary Report): Ernest M. Burgess, and Larry R. Pedegana 10-28(16-57)
— Abstract 10-28(16-17)
— Application of CET 10-28(23-25)
— Pressures, Cycle Times, and Temperature Settings 10-28(24-25)
— Background 10-28(17-20)
— CET MK II Unit 10-28(47-48)
— CET Trial Center Reports 10-28(50-54)
— Conclusions Reported From Investigating Centers 10-28(53)
— Description of Method and Equipment 10-28(20-23)
— Development of Related Management Systems 10-28(48-50)
— Experience on First 20 Cases 10-28(25-47)
— Case Studies 10-28(32-47)
— Edema Control 10-28(30-31)
— Hematoma 10-28(30)
— Infection 10-28(30)
— Pain 10-28(31)
— Time From Surgery to Definitive Prosthetic Prescription 10-28(32)
— Wound Healing Progress 10-28(25-29)
— Recommendations from Investigating Centers 10-28(54)
— Summary of CET Equipment Malfunctions 10-28(53)
— Immediate Postoperative Prosthetics Research Study. Contractor Reports: Ernest M. Burgess (Prosthetics Research Study, Seattle, Washington)
— Amputation Surgery and Amputee Rehabilitation 10-23(290-292)
— Amputation Surgery and Wound Healing 10-24(224-225)
— Controlled Environment Treatment (CET) 10-23(191-192) 10-24(224-225) 10-25(199) 10-26(301-302) 10-27(138-139) 10-28(152-155)

— Modulated Air Controlled Environment (MACE) 10-27(139)
— Physiological Suspension 10-26(304-305) 10-27(141) 10-28(155)
— Roehampton-BRADU Controlled Environment Chamber 10-21(127) 10-23(291-292) 10-25(199)
— Strain Gages Monitor Surface Skin Tension 10-27(140)
— A Proposed Technique for the Postoperative Monitoring of Skin Tension in Below-Knee Amputees: Ernest M. Burgess, Craig A. Spolek, and A. James Moore, Jr. 10-28(4-15)
— Analysis 10-28(12-14)
— Background 10-28(5-6)
— Biomechanical Model 10-28(6-7)
— Experimental Design 10-28(7-11)
— Preliminary Results 10-28(14-15)
— Suturing-In the Strain Gage 10-28(11-12)
Postura Adjustable Modular Support System
— VAPC Research Report 10-26(244-246)
Power Car Door Corp., St. Clair Shores, Michigan
— Power Car Door, VAPC Research Report 10-26(257) 10-27(116)
Power *see also* Externally Powered Prostheses; Myoelectric Controls
Powered Wheel Chair
— Recent Patents: Woodrow Seamone 10-30(290)
Powered Wheelchairs
— Mobility Aids for the Severely Handicapped. A Status Report: Charles M. Scott and Ronald E. Prior 10-26(192-213)
— VAPC Research Report 10-21(94-97) 10-25(145-153) 10-26(225-241) 10-27(107-112) 10-28(102-115)
— *See also* Wheelchairs, Mobility Aids
Power Wheelchairs *see* Powered Wheelchairs, Mobility Aids Wheelchairs
Powered Wheel Concept for Electric Wheelchairs, VAPC Research Report 10-25(147-148) 10-26(229-234)
Prahl, Jan
— Compression Sheath for Below-Knee Amputated Limbs. Recent Patents 10-27(208)
Prahl, Klaus
— Universally Movable Ankle Joint for Tube Skeleton Artificial Limbs. Recent Patents 10-24(286)
PRAHN (Powered, Reclining, Adjustable-Height, and Narrowing) Wheelchair
— University of California, Berkeley (Contractor Reports) 10-21(126) 10-24(222) 10-25(198) 10-26(294) 10-27(136) 10-28(150-151) 10-29(122) 10-30(195-196)
— VAPC Research Report 10-26(234-236)

— Variable-Height Powered Wheelchair for the Quadriplegic Driver. Don M. Cunningham, University of California, Berkeley, 10-22(337-369)
Prast, Johannes W. 1917-1975
— Notes and News 10-23(356-357)
Prast, Martin T.
— Parapodium for Adult Paraplegics: Martin T. Prast 10-22(391-403)
— Background 10-22(391-394)
— Feasibility Experiments by Prast Research Associates (PRA) 10-22(394)
— The Problem 10-22(391-392)
— Related Work of Others 10-22(392-393)
— Better Accessibility 10-22(400-401)
— Prototype Brace Development 10-22(394-400)
— Ease-of-Donning Improvements 10-22(396-399)
— Next Step Plan 10-22(400)
— Toward Self-Erection of Standing 10-22(400)
— Research and Development Project on Advanced Orthotic Devices for Adult Paraplegics. Contractor Reports: M. Prast (Prast Research Associates, Inc., Grand Island, N.Y.) 10-24(254-256) L. Carlson (Univ. of Colorado, Boulder, Colo.) 10-25(215) 10-26(340-341) 10-27(169-172) 10-28(195) 10-29(132 no report) 10-30(206)
Prast Research Associates, Grand Island, New York *see* Prast, Martin T.
Preface (VA Conference on Prosthetics and Sensory Aids): Eugene F. Murphy 10-22(10-12)
A Preliminary Followup Study of Electronic Travel Aid Users: Nancy C. Darling, Gregory L. Goodrich, and J. Kenneth Wiley (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California) 10-27(82-91)
Prentke Romich Co., Shreve, Ohio
— ECU-1 Environmental Control Unit, VAPC Research Report (Illust.) 10-27(95-96) 10-28(99)
— Prentke Romich Intercom System, VAPC Research Report 10-28(100-101)
— Remote Control AM-FM Radio, Adapted (Illust.), VAPC Research Report 10-30(121-122)
— VAPC Hospital Environmental Control, VAPC Research Report 10-26(222)
President's Committee on Employment of the Handicapped
— PCEH "Physician of the Year" Award for 1977 Goes to Robert L. Bennett, Jr., of Atlanta. Notes and News 10-28(244-245)
Pressure

— A Device Designed to Approximate Shear Forces On Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— Seat Cushions for the Paralyzed
— Device Measures Externally Applied Pressure and Shear 10-29(160-161) 10-30(258)
Pressure Distribution Pad Assembly for Wheelchairs
— Recent Patents: Matthew Hall 10-27(209)
Pressure Sore (Decubitus Ulcer) Prevention and Treatment Systems
— Action No. 6000 Bed, VAPC Research Report 10-26(251-253)
— AMBRDL Foam Microsphere Mattress (U.S. Army Medical Bioengineering Research and Development Laboratory, VAPC Research Report 10-24(194-196)
— Blair Bed, VAPC Research Report 10-24(190-191) 10-28(115-116)
— E-Z Patient Turning System, VAPC Research Report 10-28(118-119) 10-29(95-98)
— Gaymar High Density Fluidized (HDF) Bed, VAPC Research Report 10-26(251)
— Hess Rotary Bed, VAPC Research Report, VAPC Research Report 10-26(250)
— Multi-Podus Therapeutic Foot and Leg Unit, VAPC Research Report 10-26(259-261)
— RoHo Balloon Cushion, VAPC Research Report 10-28(117-119)
— Royalaire Bed, VAPC Research Report 10-26(253-254)
— Steeper "Co-Ro" Continuously Rotating Bed, VAPC Research Report 10-26(247-249)
— Therapeutic Wheelchair Rocker (Wojcik Industries) VAPC Research Report 10-25(158-159)
— Wheelchair Pad Movement Monitor, VAPC Research Report 10-28(119-121)
Pressure Sore (Decubitus Ulcer) Prevention and Treatment Research
— A Device Designed to Approximate Shear Forces On Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— Introduction 10-30(37-38)
— Edge Light: A New Approach to Studying the Microvascularization of the Skin: Jeanette F. Kissinger, Phyllis J. Verhonick and David W. Lewis 10-29(65-78)
— Edge Light Technique 10-29(68-76)
— An Attempt to Correlate Visual Contact Patterns with Interface Pressure Data (Illustrated) 10-29(68-76)
— Plexiglas Rigid Transparent Support Surface 10-29(68-76)
— Review of Techniques 10-29(66-68)

— Thermography 10-29(66)
— Seat Cushions for the Paralyzed. Contractor Reports: B.Y. Lee and L. Bennett. VA Hospital, Castle Point, New York, and VA Prosthetics Center, New York, New York 10-29(160-161) 10-30(258)
— *formerly entitled* Clinical and Physiological Evaluation of Seat Cushions for the Paralyzed
— Seating Systems for Body Support and Prevention of Tissue Trauma. Contractor Reports: I. Perkash. VA Hospital, Palo Alto, California 10-29(162-163) W. Motloch. Children's Hospital at Stanford University, Rehabilitation Engineering Center, Palo Alto, California 10-30(258-260)
— Thermographical Investigation of Decubitus Ulcers: Richard S. Trandel, David W. Lewis, and Phyllis J. Verhonick 10-24(137-155)
— Effects of Pressure on Tissue 10-24(140-142)
Prevention of Disability, and Integration of the Disabled into Community, Head List of Professionals' Priorities
— Notes and News 10-28(249)
Printed Circuit Motors for Wheelchairs
— VAPC Research Report 10-23(228-230) 10-26(229-232)
— *See also* Motorized Wheels
Printed Motors for Powered Wheelchairs
— VAPC Research Report 10-23(228-230) 10-26(229-232)
Prior, Ronald E.
— Electrocutaneous Feedback for Artificial Limbs — Summary Progress Report, February 1, 1974, through July 31, 1975: R.E. Prior and J. Lyman 10-24(3-37)
— Fundamental and Applied Research Related to the Design and Development of Upper-Extremity Externally Powered Prostheses. Contractor Reports: J.H. Lyman, A. Freedy, and R. Prior (University of California, Los Angeles, Calif.) 10-21(122-123) 10-23(284-285) 10-24(219-220) 10-25(184-194) 10-26(286-288) M. Solomonow 10-27(129-132) 10-28(139-141) 10-29(104-106) 10-30(179-181)
— Mobility Aids for the Severely Handicapped. Contractor Reports: C.M. Scott, and R.E. Prior (Mobility Engineering and Development, Inc., Canoga Park, Calif.) 10-25(212) 10-26(331 Report incorporated into article under this title, pp. 192-213) 10-27(168 —Report incorporated into article under this title, BPR 10-26, pp. 192-213) 10-28(191-192) (Van Nuys, Calif.) 10-29(158 no report) 10-30(248-255)
— Mobility Aids for the Severely Handicapped — A Status Report: Charles M. Scott and Ronald E. Prior 10-26(192-213)
— Proportionally Controlled Linear Power Assist Device for Artifi-

cial Arms: Ronald E. Prior and Charles M. Scott 10-24(43-50)
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand—Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case, and C.M. Scott 10-26(170-191)
Pritham, Charles M.
— Ultralight Below-Knee Prosthesis. Contractor Reports: A. Bennett Wilson, Jr., and Charles M. Pritham (Moss Rehabilitation Hospital, Philadelphia, Pennsylvania) 10-30(196-197)
Probes for Reading Machine
— Mauch Laboratories Cognodictor Probe Described, Illustrated 10-27(63-68)
— Mauch Laboratories Cognodictor Probe Compared with Page Scanner in Design and Function 10-27(65-67)
Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior, and Charles M. Scott 10-24(43-50)
— Abstract 10-24(43)
— Background 10-24(43-46)
— Conclusions 10-24(49-50)
— Device Description 10-24(46-49)
A Proposed Technique for the Post-operative Monitoring of Skin Tension in Below-Knee Amputees: Ernest M. Burgess, Craig A. Spolek, and A. James Moore, Jr. 10-28(4-15)
— Analysis 10-28(12-14)
— Background 10-28(5-6)
— Biomechanical Model 10-28(6-7)
— Experimental Design 10-28(7-11)
— Preliminary Results 10-28(14-15)
— Suturing-In the Strain Gage 10-28(11-12)
Prosthesis-to-Bone Interface System
— Recent Patents: Albert H. Burstein and Bertram L. Koslin 10-30(290)
Prosthetic Appliance
— Recent Patents: Richard Glabiszewski 10-30(290)
Prosthetic Brain Stimulation Devices
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Stimulating Electrodes 10-23(62-106)
— Prosthetic Devices (Illust.) 10-23(69-74)
Prosthetic Device for Holding Golf Clubs
— Recent Patents: William K. Frenzel 10-27(209-210)
Prosthetic Foot
— Recent Patents: Reinhard L. Daher and Frederick Robert Tucker 10-30(290)
Prosthetic Guitar Pick
— Recent Patents: Evan P. Gallagher 10-27(210)

Prosthetic Joint Lock and Cable Mechanism
— Recent Patents: Woodrow Seamone and John H. Loveless 10-30(290)
Prosthetic Limb with Weight-Responsive Joint Lock
— Recent Patents: La Vaughn L. Mortensen 10-26(376)
Prosthetic Materials
— Current Status — Prosthetic Materials for Maxillofacial Reconstruction: James W. Schweiger and John F. Lontz 10-22(408-409)
— New Materials: Eugene F. Murphy 10-22(406-407)
— Stump Stress Analysis, Contractor Report
— Flexible Prosthetic Socket Materials and Design Research 10-26(275-285)
Prosthetic Materials *see also* Biomaterials, Polyethylene, Polypropylene, Graphite-Epoxy
Prosthetics
— Amputation Surgery and Prosthetics: Eugene F. Murphy 10-22(79-84)
— Highlights of Other VA Research Programs. Editor: Eugene F. Murphy 10-21(109-150) 10-23(265-329) 10-24(209-256) 10-25(178-215) 10-26(272-344) 10-27(121-184) 10-28(132-224) 10-29(100-163) 10-30(176-260)
— Prosthetics (State of the Art) Henry F. Gardner 10-22(22-25)
— Publications of Interest 10-21(180-181) 10-22(531-532) 10-23(361-362) 10-24(287-288) 10-25(260-261) 10-26(377-378) 10-27(211) 10-28(259-260) 10-29(197) 10-30(293)
Prosthetics Research. Contractor Reports: Robert G. Thompson and Dudley S. Childress. Northwestern University, Prosthetics Research Laboratory, Chicago, Illinois 10-21(121-122) 10-23(282-284) 10-24(218-219) 10-25(183-184) 10-26(285) 10-27(127-129) 10-28(135-138) 10-29(100-103) 10-30(176-178)
— Above-Elbow Prosthesis Control 10-27(128)
— Atmospheric Pressure Suspension System 10-27(129) 10-30(177)
— Below-Elbow Myoelectric Fitting Techniques 10-28(136) 10-29(101-102)
— Intermediate Below-Knee Prosthesis 10-30(177-178)
— Lightweight Below-Knee Prosthesis 10-27(128) 10-28(137-138) 10-29(102) 10-30(177)
— Northwestern University Below-Elbow Socket 10-27(129)
— Powered Arm for Shoulder Disarticulation Amputees 10-28(135) 10-29(100-101) 10-30(176)
— Synergetic Hook and Hand 10-27(127-128)
— Synergetic Hook Modifications 10-30(176)
— Synergetic Hook Preliminary Evaluation 10-28(136) 10-29(100)
— Temporary Thermoplastic B/K Prostheses 10-29(102-103)

— Thoracic Suspension Harness 10-27(129)
Prosthetics Course
— First Formal University-Sponsored Course in Prosthetics in Spain, Held at Madrid. Notes and News 10-21(175)
Prosthetic Skin
— VAPC Research Report 10-26(217) 10-28(93) 10-30(120)
"Prosthetics and Orthotics International"
— New Publication of ISPO. Notes and News 10-27(201)
Prosthetics and Orthotics Research Reference Catalogue Now Available
— Notes and News 10-24(276)
Prosthetics Research Reports *see* Lower-Limb Prosthetics, Upper-Limb Prosthetics, or more specific subject areas
Prosthetics Research Study, Seattle, Washington
— Controlled Environment Treatment for Limb Surgery and Trauma (a Preliminary Report): E.M. Burgess and L.R. Pedegana 10-28(16-57)
— Immediate Postoperative Prostheses Research Study. Contractor Reports: E.M. Burgess 10-21(126-127) 10-23(290-299) 10-24(222-225) 10-25(198-200) 10-26(301-307) 10-27(137-142) 10-28(152-156) 10-29(123-124) 10-30(197-199)
— A Proposed Technique for the Postoperative Monitoring of Skin Tension in Below-Knee Amputees: E.M. Burgess, C.A. Spolek, and A.J. Moore, Jr. 10-28(4-15)
— A Survey of Lower-Limb Amputees: Prostheses, Phantom Sensations, and Psychosocial Aspects 10-27(43-60)
— A Study of Interface Pressures in the Below-Knee Prostheses (Physiological Suspension: an Interim Report): E.M. Burgess and A.J. Moore 10-28(58-70)
— Surgery as Related to Prosthetics and Orthotics: E.M. Burgess 10-22(15-21)
— Wound Healing: E.M. Burgess 10-22(109-113)
Prout, Wesley C.
— Universal Wrist System. Recent Patents 10-22(529)
Psychosociological Conference
— Notes and News 10-25(245-246)
PTB (Patellar Tendon Bearing) Prosthesis as Prescribed by VAPC Clinic Team, VAPC Research Report 10-25(177)
Publications of Interest
— Book Review: Gustav Rubin 10-22(530-531)
— General 10-21(183-185) 10-22(534-536) 10-23(363-364) 10-24(289-291) 10-25(262-264) 10-26(380-383) 10-27(213-215) 10-28(261-263) 10-29(199-200) 10-30(295-298)
— Orthotics 10-21(181-182) 10-22(532-533) 10-23(362) 10-24(288)

10-25(261) 10-26(378-379) 10-27(211-212) 10-28(260-261) 10-29(197-198) 10-30(294-295)
— Prosthetics 10-21(180-181) 10-22(531-532) 10-23(361-362) 10-24(287-288) 10-25(260-261) 10-26(377-378) 10-27(211) 10-28(259-260) 10-29(197) 10-30(293)
— Sensory Aids 10-21(182-183) 10-22(533-534) 10-23(362-363) 10-24(288-289) 10-25(261-262) 10-26(379-380) 10-27(212-213) 10-28(261) 10-29(198-199) 10-30(295)
— Surgery 10-22(534) 10-29(198) 10-30(295)
Pugh, Robert
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Binaural Sensory Aids (BSA) 10-30(98-102)
Punch, Jerry L.
— The Development of Improved Techniques for the Analaysis of Hearing-Aid Performance. Contractor Reports: G.D. Causey, J.L. Punch, H.C. Schweitzer, E. Elkins and L. Beck (University of Maryland, College Park, Md. and VA Hospital, Washington, D.C.) 10-27(191-196) 10-28(235-238) 10-29(179-185) 10-30(276-278)
Push-Button Adjustable Folding Walker
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Walkers 10-30(70-74)
Pyramid Folding Quad (Four-Footed) Cane
— VAPC Research Report 10-28(105-106)

Q

Quad Cane
— Recent Patents: Morton L. Thomas 10-30(290-291)
Quad Canes (Four-Footed)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Support or Orthopedic Canes and Crutches 10-30(56-70)
Quadriplegia
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
— A Theoretical Framework 10-25(27-28)
— Development of a Wheelchair using a Myoelectric Control System. Contractor Report: VA Hospital, West Roxbury, Massachusetts 10-29(158-159) 10-30(255-257)
— New Head Control for Quadriplegic Patients: Yves Lozac'h, Gilles Gossalin, E. David Sherman, Gustave Gingras, and Mary Ritchuk 10-23(151-157)
Quadriplegia, Quadriplegic *see also* Spinal Cord Injury

Quanbury, A.O.
— A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W.R. Dyck, S. Onyshko, D.A. Hobson, D.A. Winter, and A.O. Quanbury 10-23(169-186)

R

Rabiner, Lawrence Richard
— Speech Recognition System. Recent Patents 10-30(291)
Rabischong, Pierre
— Electrical Stimulation of Limbs. Part I—Basic Studies, Part II—Open Loop Control of Muscular Contraction: P. Rabischong, F. Bonnel, E. Dombre, E. Peruchon, P. Coiffet, B. Fournier, and J. Brebic 10-22(261-290)
— Orthopaedic Appliances. Recent Patents 10-27(209)
Radcliffe, Charles W.
— Cosmetic Covers for Lower-Limb Prostheses: C.W. Radcliffe 10-22(415-416)
— Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion. Contractor Reports: Charles W. Radcliffe, Howard D. Eberhart, Donald M. Cunningham, and James M. Morris (University of California, Berkeley, Calif.) 10-21(123-126) 10-23(285-290) 10-24(220-222) 10-25(194-198) 10-26(288-301) 10-27(132-136) Larry Lamoreux 10-29(120-122) 10-30(193-196)
— Locomotion and Lower-Limb Prosthetics: C.W. Radcliffe 10-22(167-187)
Radio Corporation of America (RCA)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Background 10-30(75-77)
— Aids Using Optical Principles 10-30(87-108)
— United States Army Signal Corps Obstacle Detector 10-30(87-88)
Radiofrequency Lesions
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Radiofrequency Lesions 10-23(103-106)
"Ramp" Range Indicating System
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Types of ETA's 10-30(82-108)
— The Lindsay Russell E Model Pathsounder 10-30(82-84)
Rancho Los Amigos Hospital, Downey, California
— Clinical Gait Analyzer (VA-Rancho). Contractor Report: J. Perry

10-21(149-150) 10-22(188-192) 10-23(329) 10-24(251-253) 10-25(214) 10-26(331-333)
— To Furnish Upper-Limb Prosthetic Systems Providing Sensory Feedback Using Surgically Implanted Electrodes, VAPC Contractual Development Program 10-24(208)
— Mobile Bed/Chair for High Level Quadriplegics. Contractor Reports: J. Perry and J.R. Allen 10-21(150) 10-23(329-330) 10-24(253) 10-26(334-339)
— Mobile/Bed Wheelchair Development: Jacquelin Perry and James Allen 10-22(370-376)
— VAPC Contractor to Evaluate Functional Electric Hand Orthosis, VAPC Contractual Development Program 10-24(208)
Reachers
— E-Z Reacher #201, VAPC Research Report 10-23(250-251)
— VAPC Illuminated Reachers for Wheelchair Users 10-28(114)
Reactive Hyperemia
— Thermographical Investigation of Decubitus Ulcers: Richard S. Trandel, David W. Lewis, and Phyllis J. Verhonick 10-24(137-155)
Readers
— Ealing Reader *see also* Saltus Reading System
— Microfiche Reader, General Teleoperators, Inc., Paramount, California, VAPC Research Report 10-25(143-144)
— New Ealing Reader, VAPC Research Report 10-27(102-103)
— Recapitulation of Development of VAPC Microfilm Reader with 35-mm Strip Film Option, VAPC Research Report, 10-26(224-226)
— Saltus Reading System (Illust.) 10-29(83-85)
— Saltus Reading System, Modified (Illust.), VAPC Research Report 10-30(123-124)
— VAPC Breath-Operated Microfiche Reader, VAPC Research Report 10-23(250)
— VAPC Projection Screen Reading Machine using 35-mm slides, VAPC Research Report 10-26(224-225)
— VAPC Microfilm Reader, Breath-Operated, Using 35mm Slides and Microfilm Strips, VAPC Research Report 10-26(224-225)
Readers Are Invited to Contribute Voluntary Abstracts of New Books and Articles of Interest to BPR Readers
— Notes and News 10-30(280)
Reading Aids for the Blind: Harvey L. Lauer 10-22(64-72)
— Blind Teachers 10-22(69)
— Comparability 10-22(68-69)
— Conclusion 10-22(72)
— Demonstrations 10-22(66-67)

— History 10-22(64-65)
— Human Factors in Learning the Skill 10-22(69)
— The Optacon 10-22(65-66)
— Other Audible Devices 10-22(65)
— Population and Future Needs 10-22(70-71)
— Scope of the Article 10-22(65)
— Some Prospects for the Future 10-22(71-72)
— Stereotoner 10-22(66)
— Studies of Utility and Reading Rates 10-22(67-68)
— Tactile Outputs 10-22(65)
— Tracking Aids 10-22(70)
— Training 10-22(67)
— Utility 10-22(67)
Reading Aids for the Blind
— The Development of Living Skills by the Handicapped: Training Program for the Stereotoner, Robert A. Weisgerber 10-22(436-438)
— Recent Patents: Hans A. Mauch, Glendon C. Smith, and Richard Bennett 10-23(359) 10-26(359)
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Conclusions 10-26(158-161)
— Desirable Auxiliary Devices and Modifications 10-26(159-161)
— Character-Recognition Possibilities 10-26(161)
— A Glance at Some Alternative Routes 10-26(146-147)
— Optical Character-Recognition is Applied 10-26(146-147)
— A Tactile Aid Evaluated 10-26(146)
— New Dimension for Sound: Development of the Stereotoner 10-26(147-148)
— Optophone Development 10-26(139-140)
— Other Activities 10-26(156-158)
— Learning to Teach the Optacon 10-26(158)
— The New Tests, Manuals, and Materials 10-26(156-158)
— The Home Study Units 10-26(157-158)
— Materials for Self-Taught Preparation for Training 10-26(157)
— Stereotoner Demonstrations 10-26(158)
— Stereotoner Evaluation Study 10-26(148-154)
— How Former Students Use the Stereotoner 10-26(154)
— Instructional Materials 10-26(151-152)
— Stereotoner Training at Hadley 10-26(150-151)
— Student Aptitude Assessment 10-26(149-150)

— Students' Backgrounds 10-26(152-154)
— Stereotoner Students, After the Research Project 10-26(154-156)
— Aid for a Sighted Instructor 10-26(154-156)
— Stereotoner User Survey 10-26(162-169)
— Results of the Survey 10-26(163-166)
— Survey Conclusions 10-26(166-167)
— Recommendations Based on Survey Responses 10-26(167)
— Telephone Survey Questionnaire 10-26(167-169)
— Visotoner Development 10-26(140-146)
— Publications 10-26(145-146)
— Recorded Visotoner Course Development 10-26(140-142)
— Visotoner Instruction at Hadley 10-26(143-145)
— Visotoner Instruction in England 10-26(143)
— *See also* Reading Machines for the Blind for complete listing of this subject
Reading Machine Employing a Two-Dimensional Multiple Snapshot Process
— Recent Patents: Hans A. Mauch and Glendon Smith 10-23(359)
Reading Machines for the Blind
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: G.M. Gillispie, W. De l'Aune, P. Gadbaw, C. Lewis (*Eastern Blind Rehabilitation Center, VA Hospital*, West Haven, Connecticut) 10-21(170-173) 10-23(348-351) 10-24(271-274) 10-25(238-241) D. Garner 10-26(360-363) 10-27(196-198) 10-28(238-240) 10-29(164-167) 10-30(261-268)
— An Evaluation of Several Different Models of Calculators 10-26(361-362)
— Published "Optacon Skill Acquisition by Blinded Veterans" 10-28(239)
— Speech-plus Talking Calculator, Preliminary Evaluation 10-27(198)
— Type-Font Parameters Affecting Reading Device Usage 10-21(171)
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, A. Wood (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California) 10-23(339-341) K. Wiley 10-24(267-268) 10-25(223-226) 10-26(354-357) 10-27(191) Report incorporated into article entitled "A Preliminary Followup: Study of Electronic Travel Aid Users" 10-27(82-91) S. Paul 10-29(171-173) 10-30(272-273)
— Optacon Activity 10-24(267) 10-25(223-224)
— Stereotoner Activity 10-24(267-268) 10-25(223)

— Clinical Trials of Reading Machines for the Blind. Contractor Reports: J.D. Malamazian and H. Lauer (Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois) 10-21(161-162) 10-23(338-339) 10-24(256-266) 10-25(221-222) 10-26(353-354) 10-27(190-191) 10-28(229-230) 10-29(170-171) 10-30(270-271)
— Kurzweil Reading Machine 10-28(229) 10-29(170-171) 10-30(270-271)
— Optacon 10-21(162) 10-23(338-339) 10-24(265-266)
— Stereotoner 10-21(161-162) 10-23(338-339) 10-24(265-266) 10-25(221-222)
— Current State of the Research Effort at Central Blind Rehabilitation Section, VA Hospital, Hines, Illinois: John D. Malamazian and Harvey Lauer
— Low-Vision Program 10-22(454-457)
— Reading Machines 10-22(451-452)
— Current State of the VA Research Effort at the Western Blind Rehabilitation Center, VA, Hospital, Palo Alto, California: Loyal E. Apple
— Electronic Reading Machines 10-22(460-461)
— Mauch Stereotoner 10-22(460)
— Telesensory Systems Optacon 10-22(460-461)
— *The Current Status of Reading Machine Research* at Haskins Laboratories: Franklin S. Cooper 10-22(439-442)
— A Description of the Kurzweil Reading Machine and a Status Report on its Testing and Dissemination: Aaron Kleiner and Raymond C. Kurzweil 10-27(72-81)
— Anti-Obsolescence Strategy 10-27(77-78)
— History and Current Status 10-27(78-81)
— NFB Participation in Development 10-27(80)
— Other Federal Programs 10-27(79-80)
— Preliminary Tests on Secondary School Children 10-27(81)
— Veterans Administration Program 10-27(79)
— The Subsystems 10-27(73-77)
— Character Recognition 10-27(75-76)
— The Scanner 10-27(73-75)
— Speech Generation 10-27(76-77)
— User Controls 10-27(77)
— Development of Correspondence Courses for Personal Reading Aids for the Blind. Contractor Reports: D.W. Hathaway and M. Butow (The Hadley School for the Blind, Winnetka, Illinois) 10-21(162-163)
— The Development and Evaluation of a Personal Reading Machine for the Blind. Contractor Reports: H.A. Mauch and G.C. Smith

(Mauch Laboratories, Dayton, Ohio) 10-21(158-160)
— The Development of Living Skills by the Handicapped: Robert A. Weisgerber 10-22(436-438)
— The Development of Personal Reading Machines for the Blind: Hans A. Mauch and Glendon C. Smith 10-22(427-432)
— Cognodictor Breadboard Development 10-22(430-432)
— Cognodictor Features 10-22(429-430)
— Stereotoner Development 10-22(428-429)
— Stereotoner Evaluation 10-22(429)
— Stereotoner Features 10-22(427-428)
— Reading Machine Accessories 10-22(432)
— Evaluation of an Ink Print Reading Aid; the Stereotoner. Contractor Reports: R.A. Weisgerber (American Insitutes for Research, Palo Alto, California) 10-25(233-236)
— Instruction In, and Evaluation of Reading Machine Techniques. Contractor Reports: D.W. Hathaway, M. Butow, and R.D. Rouse (The Hadley School for the Blind, Winnetka, Illinois) 10-23(339) 10-24(266-267) 10-25(222-223) 10-26(254) Report incorporated in article entitled "Research and Evaluation of Audible Output Print Reading Aids for the Blind — A Final Report" 10-26(139-169)
— Mobility and Reading Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports: L.E. Apple, R. Bennett, W. Ekstrom, and D.C. Cooper (VA Hospital, Western Blind Rehabilitation Center, Palo Alto, California) 10-21(163-165)
— Reading Machines for the Blind, Research and Development. Contractor Reports: Hans A. Mauch and Glendon C. Smith. Mauch Laboratories, Dayton, Ohio 10-23(336-337) 10-24(261-264) 10-25(218-219) 10-26(348-350) 10-27(187; report for this period incorporated in article under the same title, 10-27(61-71) 10-28(228-229)
— Reading Machines for the Blind, Research and Development: Glendon C. Smith, and Hans A. Mauch 10-27(61-71)
— Prototype Construction 10-27(69)
— Prototype Evaluation 10-27(70)
— Software Development 10-27(69-70)
— Progress in Cognodictor Development 10-27(62-69)
— Cognidictor Software Development 10-27(68-69)
— Reading and Mobility Aids for the Blind, Centrally Directed Clinical Application Program
— Contractor Reports: J.D. Malamazian, L.W. Farmer, and J.J. Whitehead. (Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois 10-21(160-161)

— The Reading of Printed Materials by the Blind
— Contractor Reports: R.A. Weisgerber. American Institutes for Research (AIR) Palo Alto, California 10-21(167-170) 10-23(346-348) 10-24(269-270) 10-25(233-238)
— Auditory Selection Test 10-24(269-270)
— Data Collection 10-23(347) 10-24(270)
— Evaluation of an Ink Print Reading Aid: the Stereotoner 10-25(233-236)
— Evaluation Procedures for Environmental Sensing, Orientation and Mobility by the Blind 10-25(233, 236-238)
— Final Report 10-24(270)
— Materials Development 10-23(347-348) 10-24(269)
— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: Franklin S. Cooper, Jane H. Gaitenby, Ignatius G. Mattingly, Patrick W. Nye, George N. Sholes, (Haskins Laboratories, New Haven, Connecticut) 10-21(153-158) A.M. Liberman 10-23(331-335) 10-24(256-261) 10-25(216-218) F. Ingemann, Linda Shockey 10-26(345-348) 10-27(185-187) Andrea Levitt 10-28(225-228) 10-29(173-178) 10-30(273-275)
— Comparisons of Synthetic Speech Intelligibility 10-23(333-334)
— Conclusions 10-24(261) 10-25(218) 10-26(347-348)
— Development of New Synthesis Methods 10-24(257-258)
— Development of Rules with the FOVE Program 10-27(185) 10-28(225-226)
— Direct Synthesis 10-29(174) 10-30(274)
— Extending the Speech Synthesis Program 10-25(217)
— A Flexible Software Synthesizer 10-25(217)
— Improvements to Synthesis Programs 10-25(216-217)
— Improving Current Synthetic Speech Programs 10-24(256-261)
— Introduction 10-21(153-154) 10-23(331-332) 10-24(256-257) 10-25(216) 10-26(345) 10-27(185) 10-28(225)
— Listener Comprehension on Easy Versus Difficult Texts 10-24(258-259)
— New Research on Speech Synthesis-By-Rule 10-26(346-347)
— New Synthesis Methods 10-25(218)
— Other Experiments on Duration 10-28(227)
— Print-to-Sound Conversion for Surnames 10-26(345-346)
— Print-to-Sound Rules for Proper Names 10-25(217-218)
— Research on Synthesis by Rule 10-27(186) 10-28(226) 10-29(175) 10-30(275)
— Revisions to the Synthesis Programs 10-26(345)
— Rules Development 10-29(175)
— Rules for the OVE Synthesizer 10-21(157-158)
— Segmental Cues 10-27(187) 10-28(227-228) 10-29(176-178)

— Software Synthesizer 10-29(173-174)
— Studies of Temporal Variation in Natural Speech 10-26(347)
— Synthesis From Typesetter's Tapes 10-21(156-157)
— Synthesis Playback 10-29(173)
— Synthetic Speech Comprehension 10-23(334-335)
— Synthetic Speech Evaluation 10-21(154-166)
— Synthetic Speech Improvements 10-23(332-333)
— Temporal Patterns of Syllables 10-29(175-176)
— Temporal Variation and Speech Synthesis 10-27(186) 10-28(226-227)
— Research and Development in the Field of Reading Machines for the Blind. Contractor Reports: H.A. Mauch and G.C. Smith (Mauch Laboratories, Dayton, Ohio) 10-23(336-337) 10-24(261-264) 10-25(218-219) 10-26(348-350) 10-27(187, report incorporated in article under the same title, pp. 61-71) 10-28(228-229)
— Research and Development in the Field of Reading Machines for the Blind: Glendon C. Smith and Hans A. Mauch 10-27(61-67)
— Prototype Construction 10-27(69)
— Prototype Evaluation 10-27(70)
— Software Development 10-27(69-70)
— Progress in Cognodictor Development 10-27(62-69)
— Cognodictor Software Development 10-27(68-69)
— New Cognodictor Design 10-27(62-64)
— Preprocessing and Interface Circuits 10-27(67-68)
— Probe Construction 10-27(67)
— Probe Design 10-27(64-67)
— Research and Evaluation of Audible Output Print Reading Aids for the Blind — A Final Report: Michael Carbery and Margaret Butow
— *See also* entry for this article under "Reading Aids for the Blind" for detailed listing of contents
— Teaching the Stereotoner: Its Problems and Rewards: Margaret Butow 10-22(433-435)
Recent Patents 10-21(177-179) 10-22(528-529) 10-23(358-360) 10-24(284-286) 10-25(257-258) 10-26(375-376) 10-27(208-210) 10-28(257-258) 10-29(195-196) 10-30(287-292)
Recliners
— Burris Spinal Cord Injury Recliner, VAPC Research Report 10-23(238-239)
Reclining Wheelchairs
— Design Criteria for Nonlicensed Mobility Aid (Wheelchair) Item No. 30 10-26(200)
— Electric Back-Recliner Kit, VAPC Research Report 10-28(103-104)
— Independence Powered Recliner Kits for E&J Fully Reclining

Wheelchairs, VAPC Research Report 10-30(131-133)
— Mobile Bed/Chair for High Level Quadriplegics (A Final Report). Contractor Report: Jacquelin Perry and James R. Allen. (The Professional Staff Assoc. of the Rancho Los Amigos Hospital, Downey, California 10-26(334-339)
— Mobility Aids for the Physically Disabled. Contractor Reports: Charles W. Radcliffe, Donald M. Cunningham, James M. Morris, and Larry Lamoreux (University of California, Berkeley)
— PRAHN (Powered, Reclining, Adjustable-Height and Narrowing) Wheelchairs 10-26(294) 10-27(136) 10-28(151) 10-29(122) 10-30(195-196)
— *Mobile Bed/Wheelchair Development: Jacquelin Perry and James* Allen 10-22(370-376)
— Sevier Mobile Bed Converts to Powered Wheelchair, VAPC Research Report 10-26(248-250)
— Variable-Height Powered Wheelchair for the Quadriplegic Driver: Don M. Cunningham 10-22(337-369)
— Geometric and Functional Description of Mark IV (1974) University of California Powered Variable-Height Wheelchair (PRAHN) 10-22(349-363)
Recognition Process
— Character Recognition (Kurzweil) 10-27(75-77)
— Cognodictor Design (Mauch) 10-27(62-69)
— Pattern-Recognition Arm Prosthesis: A Historical Perspective— A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Data Treatment and Analysis 10-30(13-19)
— *See also* Myoelectric Controls; Pattern Recognition;
Recording Electrodes
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Recording Electrodes
— Brain Recording 10-23(106-118)
— Heart Recording 10-23(118-123)
— Muscle Recording 10-23(123-138)
— Long-Term Muscle Recordings (Prosthetic Devices) 10-23(133-138)
Recruitment
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. A Final Report: Raymond T. Carhart and Lamar Young 10-26(9-45)
— The Effects of Peak Clipping on Intelligibility 10-26(14-31)
Redka, William
— Constant Current Power Pack for Bone Healing and Method of Use. Recent Patents 10-23(358)

Reed F. Blair, Inc., Pittsburgh, Pennsylvania
— Blair Bed, VAPC Research Report 10-24(190-191) 10-28(115-116)
Reference Collection
— VA Rehabilitative Engineering Reference Collection. Notes and News 10-29(187-188)
Reflex Viewer and Tracking Aid
— Recent Patents: Hans A. Mauch and Glendon Smith 10-25(258)
Refractive Error
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Two Modes of Processing Visual Information 10-26(54-55)
Rehabilitating Chairs for Handicapped Persons
— Recent Patents: Karl Edvin Sixten Wrethander 10-21(179)
Rehabilitation Center
— Regional Rehabilitation Center Opens in San Diego. Notes and News 10-25(251)
Rehabilitation Conferences
— Latin American Rehabilitation Conference. Notes and News 10-24(277)
— Rehabilitation Conference in Egypt. Notes and News 10-24(279)
Rehabilitation International's 14th World Congress Set for June 22-27, 1980, in Winnipeg, Canada
— Notes and News 10-27(206) 10-28(249) 10-29(189)
Rehabilitation International
— 13th World Congress. Calendar of Events 10-23(365) 10-24(292)
— 14th World Congress. Calendar of Events 10-26(387) 10-27(218) 10-28(266) 10-29(203) 10-30(301)
Rehabilitation International Medical Commission
— 4th International Seminar. Calendar of Events 10-27(218) 10-28(265) 10-29(201)
Rehabilitation Services Administration, DHEW
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— DHEW Support for Orientation & Mobility Specialist Training 10-30(50)
Rehabilitative Engineering — A New Era. An Editorial: Vernon L. Nickel 10-30(1-7)
Rehabilitative Engineering Research and Development Centers
— New Center Established at VA Hospital, Hines, Illinois. Notes and News 10-28(244)
— Second Rehabilitative Engineering Research and Development Center Established at VA Hospital, Palo Alto, California. Notes and News 10-30(283)
Rehabilitative Engineering Research and Development Service

— VA Rehabilitative Engineering Reference Collection. Notes and News 10-29(187-188)
— Vernon L. Nickel Appointed Director 10-28(243)
Reichenberger, Anton
— Automotive Aids for the Handicapped: A. Reichenberger 10-22(53-54)
— Double-Wheel Automotive Hand Control System. Recent Patents 10-30(288)
Remote Control AM/FM Radio
— VAPC Research Report 10-30(121-122)
Remote Outlet VAPC Research Report 10-28(99)
Remote Station Environmental Controls. VAPC Research Report 10-21(86)
Research on Audible Outputs of Reading Machines for the Blind *see* "Reading Machines for the Blind"
Research Center for Prosthetics *see* Office of Technology Transfer
Research and Development in the Field of Artificial Limbs *see* listing under "Artificial Limbs"
Research and Development in the Field of Reading Machines for the Blind *see* listing under "Reading Machines for the Blind"
Research and Development Project on Advanced Orthotic Devices for Adult Paraplegics *see* Prast, Martin T.
Research at the Eastern Blind Rehabilitation Center: George M. Gillispie and William De L'Aune 10-22(463-468)
Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Detailed listing appears at entry under "Reading Aids for the Blind"
Research on Hearing-Aid Design: Raymond Carhart 10-22(420-423)
Residual Vision
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Introduction 10-26(49-50)
Resilient Pivot Joint for an Artificial Leg
— Recent Patents: Albert L. Weber 10-24(285)
A Resolution for a Barrier-Free Environment
— Notes and News 10-24(276)
Reswick, James B.
— Editorial: Functional Electrical Stimulation — Neural Prosthesis for the Disabled: J.B. Reswick 10-25(1-4)
— Elected Membership to the National Academy of Engineering. Notes and News 10-26(374)
— Prosthetics, Orthotics, and Sensory Aids Research Services. Con-

tractor Reports: J. Reswick (CPRD, National Research Council-National Academy of Sciences, Wash., D.C.) 10-24(209-214)
Retinitis Pigmentosa
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
—Candidate Requirements (for Prescription of ETA's) 10-30(80)
Reyer Lift. VAPC Research Report 10-25(153)
Rigal, Waldo
— Inventor, Rigal Walker Tray, VAPC Research Report 10-29(94-95)
Rigal Walker Tray
— VAPC Research Report 10-27(105-106) 10-29(94-95)
Rigid-Fold Cane
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Types 10-30(51-54)
Riley, Leo Harold, M.D. 1919-1977
— Notes and News 10-30(285-286)
Ritchuk, M.
— New Head Control for Quadriplegic Patients: Y. Lozac'h, G. Gossalin, E.D. Sherman, G. Gingras, and M. Ritchuk 10-23(151-157)
ROBOT System
— VAPC Research Report 10-26(220)
Rochester Orthopedic Laboratories, Rochester, New York
— Manufacturers, Nitschke-Tindall Ankle Rotator, VAPC Research Report 10-28(94-95)
Rodaway, Keith S.
— Indoor/Outdoor Wheelchair Frame. Recent Patents 10-25(259)
RoHo Research and Development, Inc., Belleville, Illinois
— RoHo Balloon Cushion, VAPC Research Report 10-28(117-119)
The Role of the Committee on Prosthetics Research and Development and the Committee on Prosthetic-Orthotic Education: A. Bennett Wilson 10-22(478-486)
— Governmental Relationships 10-22(486)
— Operational Concept 10-22(485-486)
— Organization of CPRD 10-22(483-485)
— Organization of Research Program 10-22(478-480)
— Present Program Organization 10-22(482-483)
— Prosthetics Education Program 10-22(481-482)
— Public Law 729. 10-22(480)
— Suction-Socket "Schools" 10-22(480)
Rosen, Michael
— Spinal-Cord-Injury Studies: Paralysis, Spasticity, and Pain. Contractor Reports: J.W. Gesink, M. Rosen, E. Falkenberg, and J.D. Jacobi (VA Hospital, Miami, Florida) 10-23(328-329)

Rosenkrantz, Gabriel, M.D. 1896-1975
— Notes and News 10-25(253-256)
Rosenthal, Ben J.
— Motorized Wheel Chair Drive. Recent Patents 10-21(178)
Rossier, Alain B.
— Development of a Wheelchair Using a Myoelectric Control System. Contractor Reports: A.B. Rossier, M. Sarkarati, and G.E. Crawford, Jr. (VA Hospital, West Roxbury, Mass.) 10-29(158-159) 10-30(255-257)
— West Roxbury SCI Center to Apply New Care Concepts. Notes and News 10-25(251)
Rotator for Lower-Limb Orthoses
— Shoe Sole Transverse Rotator Evaluated, VAPC Research Report 10-29(81-82)
Rotators for Lower-Limb Prostheses
— Design of Prosthetic and Orthotic Devices. Contractor Reports: Charles W. Radcliffe, Don M. Cunningham, and James M. Morris (University of California, Berkeley, California)
— Effect of the UC-BL Shank Axial Rotation Unit on Selected Gait Variables 10-23(289)
— UC-BL Shank Axial Rotation Unit 10-23(285-286) 10-24(221) 10-25(195) 10-28(148-151)
— Tests of Lower-Limb Torque Absorbers, VAPC Research Report 10-24(199)
— UC-BL Torque Absorber, VAPC Research Report 10-23(219-220)
— Weber-Watkins Rotator, VAPC Research Report 10-21(74) 10-23(220)
Rotator for Prosthetic Ankle Joint
— Recent Patents: Robert R. Moore 10-26(376)
Rotators for Upper-Limb Prostheses
— A Versatile Joint Rotation Device for Externally Energized Upper-Limb Prostheses: Paul Meadows and John Lyman 10-24(38-42)
Rothman, Howard
— Development and Evaluation of a New Artificial Larynx. Contractor Reports: L. Goldstein, H. Rothman, and C. Oliver (VA Hospital, Gainesville, Florida) 10-29(186) 10-30(278-279)
Rouse, Roger D.
— Instruction In, and Evaluation Of, Reading Machine Techniques. Contractor Reports: D.W. Hathaway, M. Butow, and R.D. Rouse (The Hadley School for the Blind, Winnetka, Ill.) 10-23(339) 10-24(266-267) 10-25(222-223)
Rowell, Derek

— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Binaural Sensory Aids 10-30(98-102)
Royalaire Air-Fluidized Bed
— VAPC Research Report 10-21(104-106) 10-26(253)
Rubin, Gustav
— An Occipito-Zygomatic Cervical Orthosis Designed for Emergency Use — A Preliminary Report: G. Rubin, Malcolm Dixon, and Joel Bernknopf 10-29(50-64)
— Orthotics: Gustav Rubin and Malcolm Dixon 10-22(26-36)
Rusk, Howard A.
— Honored in 1977 Jefferson Award. Notes and News 10-28(244)
Russell, Lindsay
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Display of Environmental Information 10-30(81-82)
— Types of ETA's 10-30(82-108)
— The Lindsay Russell E Model Pathsounder 10-30(82-87)
— The SE Pathsounder 10-30(84-87)
— The Binaural Sensory Aids (BSA) 10-30(98-102)
Ryan, John P.
— Electrically Driven Hand Orthosis Device for Providing Finger Prehension. Recent Patents 10-27(208)
Ryan, Michael W.
— Artificial Foot Having Ankle Flexible Mount. Recent Patents 10-21(177)

S

SACH Feet
— Design of Prosthetic and Orthotic Devices. Contractor Reports: C.W. Radcliffe, D.M. Cunningham, J.M. Morris, and L. Lamoreux (University of California, Berkeley, California)
— Internal-Expanding Foot-to-Pylon Coupling 10-25(195)
— SACH Foot with Metal Keel 10-25(195) 10-26(291-292) 10-27(133-134) 10-28(146-148) 10-29(121) 10-30(194)
— Graphite-Epoxy SACH Foot Keels, VAPC Research Report 10-26(216)
— Physical Response of SACH Feet Under Laboratory Testing: R.L. Daher 10-23(4-50)
— Design 10-23(48-49)
— Discussion of Results 10-23(10-45)
— Kingsley High Profile 10-23(20-26)
— Construction and X-ray Analysis 10-23(22)
— Heel Resistance 10-23(20)
— Sole Resistance 10-23(20)

— Kingsley Standard 10-23(23-26)
— Construction and X-ray Analysis 10-23(24)
— Heel Resistance 10-23(23)
— Sole Resistance 10-23(24)
— Laurence 10-23(37-41)
— Construction and X-ray Analysis 10-23(38)
— Heel Resistance 10-23(37)
— Sole Resistance 10-23(37-38)
— Otto Bock — Type 1S10 10-23(16-19)
— Construction 10-23(19)
— Heel Resistance 10-23(16)
— Sole Resistance 10-23(19)
— Otto Bock — Type 1S37 10-23(10)
— Construction and X-ray Analysis 10-23(16)
— Heel Resistance 10-23(10-13)
— Sole Resistance 10-23(15)
— U.S. Manufacturing 10-23(33-37)
— Construction and X-ray Analysis 10-23(35-36)
— Heel Resistance 10-23(33)
— Sole Resistance 10-23(35)
— Wagner 10-23(42-45)
— Construction and X-Ray Analysis 10-23(44)
— Heel Resistance 10-23(42)
— Sole Resistance 10-23(42)
— Winnipeg Mk I 10-23(26-30)
— Construction and X-ray Analysis 10-23(28-29)
— Heel Resistance 10-23(26)
— Sole Resistance 10-23(28)
— Winnipeg Mk II 10-23(30-33)
— Construction and X-ray Analysis 10-23(33)
— Heel Resistance 10-23(30)
— Sole Resistance 10-23(32)
— General Test Procedures 10-23(8)
— Purpose of Study 10-23(4)
— Recommendations 10-23(46)
— Results 10-23(8-10)
— Permanent Deformation 10-23(10)
— Summary 10-23(49)
— Test Apparatus 10-23(4-7)
— Cycle Tester (2) 10-23(5-6)
— Durometer Tester (3) 10-23(6)
— X-ray Equipment 10-23(6-7)
— SACH Foot: Douglas A. Hobson 10-22(491)
— VAPC Research Report 10-23(258) 10-25(171) 10-27(117)
Sachs, Reynold

— Telecommunications System for the Hearing Impaired Utilizing Baudot-ASCII Code Selection. Recent Patents 10-25(258)
Saddle Stirrup for Use by a Leg Amputee
— Recent Patents: Douglas H. Dabney 10-23(359)
Safety During Mobility: Make McDermott, Jr., Paul H. Newell, Jr. and Lewis A. Leavitt 10-22(388-390)
St. Luke's Hospital Center, New York, N.Y.
— Acceleration of Bone Healing by Electrical Stimulation. Contractor Reports: G.V.B. Cochran 10-21(141-142) 10-22(291-294) 10-23(315-318) 10-24(238-239) Program moved to Helen Hayes Hospital, West Haverstraw, N.Y.
Saltus Reading System (previously identified as the Ealing Reader)
— VAPC Research Report (Compliance Testing) 10-30(123-124)
— VAPC Research Report 10-29(83-85)
Salt-Water-Resistant Below-Elbow Prostheses
— VAPC Research Report 10-25(137)
Samaranch, Jorge C.
— Mechanical Prosthesis of the Knee. Recent Patents 10-29(195)
Sambur, Marvin Robert
— Speech Recognition System. Recent Patents 10-30(291)
Sani-Comfo Arm Splint. VAPC Research Report 10-27(115)
Sanyo Hydraulic Walker. VAPC Research Report 10-25(153-154)
Sarkarati, Mehdi
— Development of a Wheelchair Using a Myoelectric Control System. Contractor Reports: A.B. Rossier, M. Sarkarati, and G.E. Crawford, Jr. (VA Hospital, West Roxbury, Mass.) 10-29(158-159) 10-30(255-257)
Sarmiento, Augusto
— Development of Refined Fitting Procedures for Lower-Extremity Prosthesis — Case Studies of Applied Research in Orthotics and Prosthetics. Contractor Reports. A. Sarmiento, N.C. McCollough, and W.F. Sinclair (University of Miami, Miami, Florida) 10-21(136-137) 10-23(310-311) L. Latta 10-24(234-235) 10-25(204) 10-26(317) 10-28(162-178)
— Development of Refined Fitting Procedures for Lower-Limb Prostheses: A. Sarmiento 10-22(114-132)
Sato, Takuya R.
— Bioelectrodes. Recent Patents 10-29(195)
Scadden, L.A.
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Tactile Vision Substitution System 10-30(109-111)
Schally, Andrew V.
— VA Nobel Prize Winner in Medicine. Notes and News 10-28(243-244)
Schlenz, Louis W.

— Noise Compensation Techniques for Bioelectric Potential Sensing. Recent Patents 10-26(376)
Schmeisser, Gerhard, Jr.
— A Five-Year Review of Clinical Experience with Johns Hopkins University Externally Powered Upper-Limb Prostheses and Orthoses: G. Schmeisser, Jr., and W. Seamone 10-23(211-217)
— Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prostheses and Orthoses. Contractor Reports: W. Seamone and G. Schmeisser (The Johns Hopkins Univ., Silver Spring, Md.) 10-21(128-136) 10-23(300-310) 10-24(225-234) 10-26(307-316) 10-27(142-149) 10-28(157-162) Laurel, Md. 10-29(109-117) 10-30(185-192)
— Shoulder Disarticulation Prosthetic Systems. Recent Patents 10-23(359)
— Status of the Johns Hopkins Research Program on Upper-Limb Prosthesis-Orthosis Power and Control System: W. Seamone and G. Schmeisser, Jr. 10-22(237-244)
Schmidl, Hannes
— The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients with Myoelectric Control: H. Schmidl 10-27(17-42)
Schulz, Eduard
— Engineering Applications in Orthotic and Prosthetic Treatment of Musculoskeletal Defects. Contractor Reports: E.B. Marsolais, A. Burstein, and E. Schulz (VA Hospital, Wade Park, Cleveland, Ohio) 10-26(341-344) 10-27(172-174) 10-28(195-214) 10-29(127-129) 10-30(201)
Schwartz, Arthur
— Stand-up Wheelchair. Recent Patents 10-22(529)
Schweiger, James W.
— Current Status — Prosthetic Materials for Maxillofacial Reconstruction: J.W. Schweiger and J.F. Lontz 10-22(408-409)
— Maxillofacial Restorative Biomaterials and Techniques. Contractor Reports: J.W. Schweiger, and J.F. Lontz (Temple Univ. School of Dentistry, Philadelphia, Pa.) 10-21(143-145) 10-23(319-321) 10-24(241-243) 10-25(210-211) 10-26(323-330) 10-27(161-165) 10-28(182-188) 10-29(145-155) 10-30(223-244)
Schweitzer, Howard C.
— The Development of Improved Techniques for the Analysis of Hearing-Aid Performance. Contractor Reports: G.D. Causey, J. Punch, H. Schweitzer, E. Elkins, and L. Beck (VA Hospital, Wash., D.C. and University of Maryland, College Park, Md.) 10-27(191-196) 10-28(235-238) 10-29(179-185) 10-30(276-278)
Scientific Systems International, Huntsville, Alabama
— Nu-Life Environmental Control System 10-24(168-171)
— VAPC Contract to Develop Five-Station Food Server for Quad-

riplegics, VAPC Contractual Development Program, VAPC Research Report 10-24(208)
Scope Electronics, Inc., Reston, Virginia
— Mechanically Operated Voice Synthesizer (MOVS) 10-27(100-101)
— VAPC Contractor to Fabricate Mechanically Operated Voice Synthesizer for Dysarthria, VAPC Contractual Development Program, VAPC Research Report 10-24(208)
— Voice Recognition System. VAPC Research Report 10-21(92-93)
— VOTECS (Voice Operated Typewriter and Environmental Control System 10-23(246-248)
Scott, Charles M.
— Driver Safety in Modified Vans: C.M. Scott 10-22(377-387)
— Hydraulic Flexion Control Device. Recent Patents 10-22(528)
— Mobility Aids for the Severely Handicapped. Contractor Reports: C.M. Scott (Mobility Engineering and Development, Inc., Playa Del Rey, Calif.) 10-23(327-328) 10-24(249-250) R.E. Prior 10-25(212) (Canoga Park, Calif.) 10-26(331) 10-27(168) For period covered by BPR 10-26 and BPR 10-27 *see* article "Mobility Aids for the Severely Handicapped — A Status Report" 10-26(192-213). 10-28(191-192) 10-29(158 no report) 10-30(248-255)
— Mobility Aids for the Severely Handicapped — A Status Report: C.M. Scott and R.E. Prior 10-26(192-213)
— Passenger Safety in Vehicles for the Handicapped. Contractor Reports: C.M. Scott (Mobility Engineering & Development, Inc., Playa Del Rey, Calif.) 10-21(145-146)
— Proportionally Controlled Linear Power Assist Device for Artificial Arms: R.E. Prior and C.M. Scott 10-24(43-50)
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand — Background and Preliminary Designs: R.E. Prior, J. Lyman, P.A. Case, and C.M. Scott 10-26(170-191)
Scott, Walter L.
— Tactile Sensing Means for Prosthetic Limbs. Recent Patents 10-21(179)
Seamone, Woodrow
— A Five-Year Review of Clinical Experience with Johns Hopkins University Externally Powered Upper-Limb Prostheses and Orthoses: W. Seamone and G. Schmeisser 10-23(211-217)
— Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prosthesis. Contractor Reports: W. Seamone, and G. Schmeisser, Jr. (The Johns Hopkins University, Silver Spring, Md.) 10-21(128-136) 10-23(300-310) 10-24(225-234) 10-25(200-203) 10-26(307-316) 10-27(142-149) 10-28(157-162) Laurel, Md. 10-29(109-117) 10-30(185-192)
— Myoelectrically Controlled Prosthesis. Recent Patents 10-27(209)

— Powered Wheel Chair. Recent Patents 10-30(290)
— Prosthetic Joint Lock and Cable Mechanism. Recent Patents 10-30(290)
— Shoulder Disarticulation Prosthetic System. Recent Patents 10-23(359)
— Status of the Johns Hopkins Research Program on Upper-Limb Prosthesis-Orthosis Power and Control System: W. Seamone and G. Schmeisser, Jr. 10-22(237-244)
A Search for Better Limbs: Prosthetic Research at Northwestern University: Dudley S. Childress, John N. Billock, and Robert G. Thompson 10-22(200-212)
Seat Cushions for the Paralyzed
— Contractor Reports: Bok Y. Lee and Leon Bennett. VA Hospital, Castle Point, New York, and VA Prosthetics Center, New York, New York 10-29(160-161) 10-30(258)
—*formerly entitled* Clinical and Physiological Evaluation of Seat Cushions for the Paralyzed
Seating Systems for Body Support and Prevention of Tissue Trauma
— Contractor Reports: Inder Perkash. VA Hospital, Palo Alto, California 10-29(162-163) Wallace Motloch. The Children's Hospital at Stanford University, Rehabilitation Engineering Center, Palo Alto, California 10-30(258-260)
— Comments 10-29(163)
— Concept 10-29(162)
— Plan 10-29(162-163)
— Purpose 10-29(162)
Secondary Travel Aids
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Guidelines for Design 10-30(78-80)
Second International Symposium for Facial Prostheses at San Antonio, Texas, May 1978
— Notes and News 10-26(366)
Second Rehabilitative Engineering Research and Development Center Established at VAH, Palo Alto, California
— Notes and News 10-30(283)
Seeing Eye Cane
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Wheeled Canes 10-30(55)
"Selected Articles From Artificial Limbs" Available
— Notes and News 10-24(281)
Sele, George J.F.
— Medical Appliance. Recent Patents 10-21(178)
Seliktar, Rahamin
— A Kneeless Leg Prosthesis for the Elderly Amputee, Advanced Version: Rahamin Seliktar and R.M. Kenedi 10-25(97-118)

Sensing Whiskers
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Wheeled Canes 10-30(55)
Sensor Device
— Control Input-Sensor Development (for use with eyeglass frames). Contractor Reports: W. Seamone and G. Schmeisser, Jr. (Johns Hopkins University, Silver Spring, Maryland) 10-21(134-135)
Sensorineural Hearing Loss
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. A Final Report: Raymond T. Carhart and Lamar Young 10-26(9-45)
— Discrimination of Speech in Quiet and in Noise 10-26(10-11)
Sensor Techniques
— Status of the Johns Hopkins Research Program on Upper-Limb Prosthesis-Orthosis Power and Control System: Woodrow Seamone and Gerhard Schmeisser, Jr.
— Control Input Sensor Development 10-22(242-244)
— Skin Motion Sensor 10-22(240)
— Single-Site EMG Sensor 10-22(238)
Sensory Aids
— Highlights of Other VA Research Programs: Sensory Aids. Editor: Howard Freiberger 10-21(150-173) 10-23(330-352) 10-24(256-275) 10-25(215-242) 10-26(344-364) 10-27(185-200) 10-28(225-242) 10-29(164-186) 10-30(261-279)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Electronic Travel Aids (ETA's): History and Development 10-30(75-108)
— Functions Performed by ETA's 10-30(77-78)
— Publications of Interest 10-21(182-183) 10-22(533-534) 10-23(362-363) 10-24(288-289) 10-25(261-262) 10-26(379-380) 10-27(212-213) 10-28(261) 10-29(198-199) 10-30(295)
— Sensory Aids Workshop: A. Bennett Wilson, Jr. 10-22(509-512)
Sensory Aids Evaluation and Development Center (SAEDC), M.I.T.
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Lindsay Russell E Model Pathsounder 10-30(82-84)
Sensory Aids: Howard A. Freiberger 10-22(417-419)
Sensory Aids Workshop: A. Bennett Wilson, Jr. 10-22(509-512)
— Acoustic Cues for Mobility of the Blind 10-22(509-510)
— Evaluation 10-22(511)
— General 10-22(511-512)
— Hand-Held Calculators 10-22(511)
— The Haskins System 10-22(511)
— Hearing Aids 10-22(511)
— Low Vision Aids 10-22(510)

— Prevention and Early Identification of Blindness 10-22(510)
— Reading Aids 10-22(510)
Sensory Aids *see also* Laser Cane, Low Vision Aids, Electronic Travel Aids, Mobility Aids for the Blind, Reading Aids, Reading Machines
Sensory Feedback
— Clinical Evaluation of a Sensory Feedback Device: The Limb Load Monitor: Gunilla Wannstedt and Rebecca Craik 10-29(8-49)
— Electrocutaneous Feedback for Artificial Limbs. Summary Progress Report. February 1, 1974, Through July 31, 1975: Ronald E. Prior and John Lyman 10-24(3-37)
— Basic Research Studies of Electrocutaneous Stimulation Parameters 10-24(6-19)
— Comparison of Bipolar and Monopolar Stimulation 10-24(13-14)
— Investigation of Undesired Interaction Between Myoelectric Control and Electrocutaneous Feedback When Used Simultaneously in An Arm Prosthesis 10-24(15-19)
— Methods of Encoding Sensory Feedback Parameters: Single and Multiple Electrodes 10-24(6-13)
— Other Research Studies of Electrocutaneous Stimulation Parameters 10-24(19)
— Clinical Evaluation of Prototype Electrocutaneous Sensory Feedback Signals for Prostheses and Orthoses
— Design and Development of Several Different Electrocutaneous Feedback Systems 10-24(4-6)
— Design and Evaluation of a Prosthesis Control Harness for Use by Non-Amputees to Assist Them in Conducting Research and Development of Artificial Arms 10-24(28-29)
— Determination of the Feasibility of a Proportionally Controlled Linear Power Assist Device for Conventional Cable-Operated Above-Elbow Prostheses 10-24(29-30)
— Investigation of the Effectiveness of Various Supplemental Electrocutaneous Sensory Feedback Signals for Prostheses and Orthoses 10-24(19-22)
— Refinement and Clinical Evaluation of Harness Mounted Proportional Controllers/Electrocutaneous Feedback Packages for Use With Commercially Available Switch Controlled Electric Hands and Elbows 10-24(22-28)
— *See also* "Supplemental Sensory Feedback"
— Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses. Contractor Reports: John H. Lyman, Amos Freedy, Ronald Prior, and Moshe Solomonow (University of California, Los Angeles, California)
— Electrotactile Sensory Aids 10-29(104-105) 10-30(179)

— Prosthesis Sensory Feedback 10-28(140)
— Sensory Feedback Studies 10-23(284) 10-25(193-194) 10-26(287-288)
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Background and Information: "Artificial Hands and Hooks Require Sensory Feedback Systems"
— Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior and Charles M. Scott 10-24(43-50)
— Abstract 10-24(43)
— A Sensory Feedback System for an Upper-Limb Amputation Prosthesis: Frank W. Clippinger, Roger Avery, and Bert R. Titus 10-22(247-258)
— Electronics 10-22(243-255)
— Functional Testing 10-22(256-257)
— Problems 10-22(256)
— The Prosthesis 10-22(252-253)
— Prosthetic Response and Acceptance 10-22(256)
— Surgery 10-22(251-252)
— Testing Response 10-22(252)
— Studies Toward a Practical Computer-Aided Arm Prosthesis System: John Lyman, Amos Freedy, and Moshe Solomonow
— Sensory Feedback 10-22(216-217)
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand. Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case and Charles M. Scott 10-26(170-191)
— Performance of VA/NU Myoelectric Hand without Supplemental Feedback 10-26(175-178)
— Statement of the Problem 10-26(170-171)
— Supplying Supplemental Sensory Feedback to the Patient 10-26(171-173)
— Undesired Interaction between Myoelectric Control and Electrocutaneous Feedback 10-26(173-175)
— Preliminary Design of SSF Systems for the VA/NU Myoelectric Hand 10-26(178-179)
— Design of Three SSF Systems for the VA/NU Myoelectric Hand 10-26(180-189)
— Four-Electrode Grasp Force, Single-Electrode Hand Opening, SSF System 10-26(186-189)
— Single-Electrode Hand Opening SSF System 10-26(180-182)
— Two-Electrode Grasp Force and Hand Opening SSF System 10-26(182-186)
— A System to Provide Physiologic Sensation From an Upper-Limb

Amputation Prosthesis. Contractor Reports: F.W. Clippinger, Jr., Duke University Medical Center, Durham, North Carolina 10-21(141 no report) 10-22(247-258) 10-23(315 no report)
— VAPC Contract with Rancho Los Amigos Hospital to Furnish Upper-Limb Prosthesis Systems with Sensory Feedback Using Surgically Implanted Electrodes, VAPC Contractual Development Program, VAPC Research Report 10-24(208)
Septicemia
— Thermographical Investigation of Decubitus Ulcers: Richard S. Trandel, David W. Lewis, and Phyllis J. Verhonick 10-24(137-140)
Serif Corp., Ltd., Jerusalem, Israel
— ROBOT System (Remote Operation by Oral Triggering), VAPC Research Report 10-26(220-221)
Service of the VAPC Clinic Team
— VAPC Research Report 10-24(205)
Servo-Control Systems (Automotive Adaptive)
— Servo-Control System Test and Evaluation. Contractor Reports: M. McDermott, Jr. and L.A. Leavitt (Texas A&M University, College Station, Texas) 10-24(235-236) 10-25(206) 10-26(318)
Servo-Type Driving Controls for the Handicapped. VAPC Research Report 10-23(253-254)
Sevier Manufacturing Co., Sevierville, Tenn., Sevier Mobile Bed 10-26(248-250)
Sevier Mobile Bed
— VAPC Research Report 10-26(248-250)
Shaffer, Donald K.
— Inflation Device for a Pneumatic Orthosis. Recent Patents 10-29(195)
Shank Axial Rotation Devices
— Design of Prosthetic and Orthotic Devices. Contractor Reports: Charles W. Radcliffe, Don M. Cunningham, and James M. Morris (University of California, Berkeley, California) 10-23(289) 10-24(221) 10-25(195) 10-28(148-151)
Sharp, Paul K.
— Electrically Driven Hand Orthosis Device for Providing Finger Prehension. Recent Patents 10-27(208)
Shear Forces *see* Shear Gage
Shear Gage
— A Device Designed to Approximate Shear Forces On Human Skin (A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— The Physical Shear Gage 10-30(45-46)
Shear Stresses *see* Shear Gage
Sheredos, Carol R.

— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: E.A. Lewis, C.R. Sheredos, T.T. Sowell, and V.L. Houston 10-24(51-136)

Sherman, E. David

— New Head Control for Quadriplegic Patients: Yves Lozac'h, Gilles Gossalin, E. David Sherman, Gustave Gingras, and Mary Ritchuk 10-23(151-157)

Shiavi, Richard G.

— Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects. Contractor Reports: Paul P. Griffin, and R.G. Shiavi (VA Hospital, Nashville, Tenn.) 10-29(144-145) also Sherry Champion and Frank Freeman 10-30(217-223)

Shock Absorber Attachment for Wheelchairs or the Like

— Recent Patents: Andrew Marvin Ferguson and Ernest Voshell Keith 10-30(291)

Shockey, Linda

— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: Franklin S. Cooper, Jane H. Gaitenby, Frances Ingemann, Ignatius G. Mattingly, Patrick W. Nye, and Linda Shockey (Haskins Laboratories, Inc., New Haven, Conn.) 10-26(344-345) 10-27(185-187) 10-28(225-228) Andrea Levitt 10-29(173-178) 10-30(273-275)

Shoes and Shoe-Related Devices

— Shoe-Sole Transverse Rotator (Orthotic) Evaluated, VAPC Research Report 10-29(81-82)

Sholes, George N.

— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: F.S. Cooper, J.H. Gaitenby, I.G. Mattingly, P.W. Nye, and G.N. Sholes (Haskins Laboratories, Inc., New Haven, Conn.) 10-21(153-158) A. Liberman 10-23(331-335) 10-24(256-261) 10-25(216-218)

"Shorelining"

— Mobility Devices: Leicester W. Farmer 10-30(47-118)

— The C-5 Laser Cane 10-30(91-95)

Shoulder-Disarticulation Prostheses

— The I.N.A.I.L Experience Fitting Upper-Limb Dysmelia Patients with Myoelectric Control: H. Schmidl 10-27(17-42)

— Powered Arm for Shoulder Disarticulation Amputees. Contractor Reports: R.G. Thompson and D.S. Childress (Northwestern University, Chicago, Illinois) 10-26(285) 10-28(135) 10-29(100-101) 10-30(176-177)

— Shoulder-Disarticulation Prosthesis. Contractor Reports: W. Seamone and G. Schmeisser, Jr. (Johns Hopkins University, Silver Spring, Maryland) 10-21(129-130)

Shoulder Disarticulation Prosthetic Systems

— Recent Patents: Woodrow Seamone and Gerhard Schmeisser, Jr. 10-23(359)
Shower Chairs
— Wayne Chair, VAPC Research Report 10-25(159-161)
Shrink Resistant Woolen Stump Socks, VAPC Research Report 10-25(172)
Sierra/APRL 44 Voluntary Closing Hand, VAPC Research Report 10-21(108)
Sierra/APRL Voluntary Closing Hook, VAPC Research Report 10-21(108)
Sierra Voluntary-Closing Hand (Compliance Testing), VAPC Research Report 10-28(129)
Signal Compression and Expansion Apparatus with Means for Preserving or Varying Pitch
— Recent Patents: Richard F. Koch 10-30(291)
Silent Communications, Inc., Oakland, California, Manual Communication Module, VAPC Research Report 10-27(98)
Silver Electrodes
— Silver Bacteriostatic Electrodes
— Use of Anodic Silver Electrodes in the Treatment of Osteomyelitis 10-30(208)
— Silver Electrodes *see also* Electrical Stimulation of Hard Tissue Growth, Electrodes
— Silver-Silver Chloride Electrodes
— Pattern-Recognition Arm Prosthesis: A Historical Perspective —A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Electrodes and Electrode Support 10-30(23-25)
Silver, Robert H.
— Subminiature Insertable Force Transducer. Recent Patents 10-26(376)
Simmons, Alden C.
— Wheelchair-Mounted Control Apparatus. Recent Patents 10-27(210)
Simmons Electric Bed, VAPC Research Report 10-23(241)
Simplified Artificial Leg Structure with Articulated Knee Joint
— Recent Patents: Orval L. Minor 10-25(258)
Sinclair, William F.
— Development of Refined Fitting Procedures for Lower-Extremity Prosthesis. Contractor Reports: A. Sarmiento, N.C. McCollough, and W.F. Sinclair (University of Miami, Miami, Florida) 10-21(136-137)
Single-Electrode Hand Opening SSF System *see* "Supplemental Sensory Feedback for the VA/NU Myoelectric Hand. Background and Preliminary Designs"
The Single Object Sensor (SOS) Bui Device

— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Other Electronic Devices and Systems 10-30(102-108)
Sinkette Corp., Gardenbill, Pennsylvania
— Manufacturer, Porta-Care Sink, VAPC Research Report 10-30(145-146)
Sip "N" Puff Dialer, VAPC Research Report 10-27(104-105)
Skeletal Extension Development: Criteria for Future Designs: Charles William Hall, P.A. Cox, and William A. Mallow 10-25(69-96)
— Animal Models and Surgical Procedures 10-25(79-81)
— Model Development 10-25(72-79)
— Artificial Tendon 10-25(76-79)
— Intermedullary Rod Extension 10-25(72-74)
— Supracortical Extension 10-25(74-76)
— Results 10-25(86-92)
— Stresses in the Bone and Supracortical Extension 10-25(81-86)
— Tissue Interfacing 10-25(70-72)
— Bone Interfacing 10-25(71)
— Musculotendinous Interfacing 10-25(71)
— Skin Interfacing 10-25(70)
Ski-Equipped Crutch
— Recent Patents: Takafusa Negi 10-26(376)
Skid Resistance
— Slipping Cane and Crutch Tips Part I — Static Performance of Current Devices: Leon Bennett and Eugene F. Murphy 10-28(71-90)
Skin
— Skeletal Extension Development: Criteria for Future Designs: Charles William Hall, P.A. Cox, and William A. Mallow 10-25(69-96)
— Skin Interfacing 10-25(70)
— Thermographical Investigation of Decubitus Ulcers: Richard S. Trandel, David W. Lewis, and Phyllis J. Verhonick 10-24(137-155)
Skin Blood Flow
— Below-Knee Amputation with Immediate Postoperative Fitting of Prosthesis. Contractor Reports: W.S. Moore, A.D. Hall, and L.A. Wilson (VA Hospital, San Francisco, California) 10-21(128) 10-23(300) 10-24(225, no report) 10-25(200, no report) 10-26(307) 10-27(142, no report) 10-28(156, no report) (VA Hospital, Tucson, Arizona) 10-29(124-125) 10-30(199)
— Hemodynamic Evaluation of Postoperative and Preoperative Amputees. Contractor Reports. B.Y. Lee, F.S. Trainor, J.L. Madden, E. Ejercito (VA Hospital, Castle Point, N.Y.) 10-21(142-143) 10-23(318-319) 10-24(239-240) D. Kavner 10-25(209-210) 10-

26(322-323) 10-27(158-161) 10-28(180-181) 10-29(125-127) 10-30(199-200)
— Non-Invasive Techniques as an Aid to Determination of Amputation Level 10-30(199)
— Immediate Postoperative Prostheses Research Study. Contractor Reports: Ernest M. Burgess (Prosthetics Research Study, Seattle, Washington)
— Preamputation Level Determination and Skin Blood Flow Research 10-26(302-303)
— Revision Amputation 10-28(156)
— Studies of Skin Blood Flow as Related to Amputation Level 10-28(155)
— Xenon 133 Testing 10-27(139-140)
Skin Blood Flow and Healing: Wesley S. Moore 10-22(105-108)
Skin Blood Flow *see also* Pressure Sore Prevention and Treatment Systems. *See also* Skin Pressure Prevention (below)
Skin Interfacing
— Developing a Permanently Attached Artificial Limb: C. William Hall
— Musculotendinous Skin Interfacing 10-22(151-153)
— Skin Interfacing 10-22(145-151)
Skin Pressure Prevention
— Seating Systems for Body Support and Prevention of Tissue Trauma. Contractor Reports: I. Perkash (VA Hospital, Palo Alto, California) 10-29(162-163) W. Motloch (The Children's Hospital at Stanford University, Palo Alto, California) 10-30(258-260)
— Seat Cushions for the Paralyzed. Contractor Reports: Bok Y. Lee and Leon Bennett (VA Hospital, Castle Point, New York, and VA Prosthetics Center, New York, New York) 10-29(160-161) 10-30(258)
— *See also* Pressure Sore (Decubitis Ulcer) Prevention and Treatment Systems
Skin Tension
— A Proposed Technique for the Postoperative Monitoring of Skin Tension in Below-Knee Amputees: Ernest M. Burgess, Craig A. Spolek, and A. James Moore, Jr. 10-28(4-15)
Slipping Cane and Crutch Tips Part I—Static Performance of Current Devices: Leon Bennett and Eugene F. Murphy 10-28(71-90)
— Conclusions 10-28(90)
— Discussion 10-28(86-90)
— Effects of Age 10-28(89-90)
— Effects of Size 10-28(89)
— Some Assets 10-28(87)
— Some Cautions 10-28(86-87)

— Special Devices 10-28(88-89)
— Special Hazards 10-28(87-88)
— Thrust Load 10-28(89)
— Experimental Methods and Procedure 10-28(73-83)
— Results 10-28(84-86)
— Ice 10-28(84-86)
— Soapy Wet Tile 10-28(86)
Smith, Claudette A.
— The Reading of Printed Materials by the Blind (Evaluation of an Ink Print Reading Aid: The Stereotoner). Contractor Reports: Robert A. Weisgerber, Bruce E. Everett, and Claudette A. Smith (American Institutes for Research (AIR), Palo Alto, Calif.) 10-25(233, 236-238)
Smith, Glendon C.
— *The Development and Evaluation of a Personal Reading Machine* for the Blind. Contractor Reports: Hans A. Mauch, and Glendon C. Smith (Mauch Laboratories, Inc., Dayton, Ohio) 10-21(158-160)
— The Development of Personal Reading Machines for the Blind: H.A. Mauch and G.C. Smith 10-22(427-432)
— Reading Aid for the Blind. Recent Patents 10-23(359) 10-26(376)
— Reading Machine Employing a Two-Dimensional Multiple Snapshot Process. Recent Patents 10-23(359)
— Reflex Viewer and Tracking Aid. Recent Patents 10-25(258)
— Research and Development in the Field of Artificial Limbs. Contractor Reports: H.A. Mauch, and G.C. Smith (Mauch Laboratories, Inc., Dayton, Ohio) 10-25(183-184)
— Research and Development in the Field of Reading Machines for the Blind. Contractor Reports: H.A. Mauch, and G.C. Smith (Mauch Laboratories, Inc., Dayton, Ohio) 10-23(336-337) 10-24(261-264) 10-25(218-219) 10-26(348-350) 10-27(61-71 Report incorporated into article under same title) 10-28(228-229)
— Research and Development in the Field of Reading Machines for the Blind: G.C. Smith and H.A. Mauch 10-27(61-71)
Smith-Kettlewell Institute of Visual Sciences
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Tactile Vision Substitution System 10-30(109-111)
Snipas Glucose Analyzer
— Data Collected for Evaluation of Snipas Glucose Analyzer. Notes and News 10-27(207)
— Glucose Analyzer Tested. Contractor Reports (VA Hospital, Hines, Illinois) 10-28(231-232)
S-N-S System (Swing and Stance)
— The Development of Artificial Limbs for Lower Limbs: Hans A. Mauch

— Development of a Mechanical Version of the S-N-S System 10-22(159-160)
— Development of the S-N-S System 10-22(159)
— Development of the Voluntary Swing- and Stance-Control System 10-22(165-166)
— Features of the S-N-S System 10-22(158-159)
— Features of the Voluntary Swing and Stance—Control System 10-22(164-165)
— Research and Development in the Field of Artificial Limbs. Contractor Reports. H.A. Mauch (Mauch Laboratories, Dayton, Ohio) 10-21(118-119) 10-23(279-280) 10-24(214-215) 10-27(122) 10-28(134)
— Voluntarily Actuated Swing and Stance Control System 10-29(119-120)
The Society for Biomaterials
— Annual Conference in Conjunction With the International Biomaterial Symposium. Calendar of Events 10-24(292) 10-26(384, 386) 10-27(217) 10-28(265) 10-29(202) 10-30(299)
Socket Pressure
— Atmospheric Pressure Suspension Systems. Contractor Reports: R.G. Thompson, and D.S. Childress (Northwestern University, Chicago, Illinois) 10-27(129) 10-30(177)
— A Study of Interface Pressures in the Below-Knee Prosthesis (Physiological Suspension) — an Interim Report: Ernest M. Burgess and A. James Moore 10-28(58-70)
— Stump Stress Analysis. Contractor Reports: L. Bennett (New York University, New York) 10-24(217-218) 10-25(182-183) 10-26(275-285)
— Transferring Load to Flesh: Leon Bennett 10-22(133-143)
Sockets *see also* Below Knee Sockets, etc.
Sole Resistance
— Physical Response of SACH Feet Under Laboratory Testing: R.L. Daher 10-23(4-50)
— Discussion of Results 10-23(10-44)
Solo Products, Sacramento, California
— Electronic Power Conversion Kit for Wheelchairs, VAPC Research Report 10-26(246-247) 10-28(102-103) 10-29(85-88)
Solomonow, Moshe
— Functional Neuromuscular Stimulation of Limbs: A Feasibility Study. Contractor Reports: J.A. Foster, and M. Solomonow (VA Hospital, Los Angeles, California) 10-30(203-205)
— Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses. Contractor Reports: J.H. Lyman, A. Freedy, R. Prior, and M. Solomonow (University of California, Los Angeles, Calif.) 10-

27(129-132) 10-28(139-141) 10-29(104-106)
— Studies Toward a Practical Computer-Aided Arm Prosthesis System: J. Lyman, A. Freedy, and M. Solomonow 10-22(213-225)
SOMI (Sternal-Occipital-Mandibular Immobilizer) Orthosis, Comparison with, *see* An Occipito-Zygomatic Cervical Orthosis Designed for Emergency Use — A Preliminary Report 10-29(50-64)
Sonar Transmitters
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
The Sonicguide
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Binaural Sensory Aids (BSA) 10-30(98-102)
— Candidate Requirements 10-30(80)
— Considerations in Selection 10-30(80-81)
— Definition and Purpose 10-30(77)
— Display of Environmental Information 10-30(81-82)
— Electronic Travel Aids (ETA's): History and Development 10-30(75-108)
— Sonicguide for Children 10-30(100)
— The Sonicguide Mk II 10-30(98-100)
— Training 10-30(101)
— Functions Performed by ETA's 10-30(77-78)
— A Preliminary Followup Study of Electronic Travel Aid Users: Nancy C. Darling, Gregory L. Goodrich, and J. Kenneth Wiley. Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California 10-27(82-91)
Sonicguide *see also* Electronic Travel Aids; Mobility Aids for the Blind
Southwest Research Institute, San Antonio, Texas
— Developer, Wheelchair Pad Movement Monitor (Illust.), VAPC Research Report 10-28(119-121)
— Permanently Attached Artificial Limbs. Contractor Reports: C.W. Hall and W. Mallow 10-21(145) 10-23(321-327) 10-24(243-249) 10-25(211-212) 10-26(331) 10-27(165-168) 10-28(188-191) 10-29(155-157) 10-30(245-248)
— VAPC Contractor to Adapt NASA Lunar Vehicle Control Stick for Terrestrial Vehicles, VAPC Research Report 10-24(208)
— VAPC Contractor to Develop Electromechanical Physiological Geriatric Monitor, VAPC Contractual Development Program, VAPC Research Report 10-24(208)
Sowell, Tamara T.
— Biographical Note on Donald A. Covalt, M.D., 1906-1977. Notes and News 10-28(253-255)
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)

Space Shuttle — 1980's
— Notes and News 10-29(189)
Spadaro, J.A.
— Evaluation of Electrical Techniques for Stimulation of Hard Tissue Growth. Contractor Reports: Robert O. Becker, J.A. Spadaro, and A.A. Marino (VA Hospital, Syracuse, N.Y.) 10-27(180-184) 10-28(224 no report) 10-29(133-136) 10-30(206-209)
Spasticity
— Evaluation of Electrical Stimulation as a Treatment for the Reduction of Spasticity: Ross Davis and John W. Gesink 10-22(302-309)
Special Case Histories (VAPC Clinic Team) 10-25(174-177)
Special Mobility Aid for Veteran with Hemipelvectomy, VAPC Research Report 10-26(239-241)
Special Phone Services Booklet
— Notes and News 10-23(354)
Special Vans Driven by Paralyzed Vets from N.Y. to Washington, D.C.
— Notes and News 10-22(522-524)
Speech Generation *see* Reading Machines, *see also* Synthetic Speech
Speech Intelligibility
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. A Final Report: Raymond T. Carhart and Lamar Young 10-26(9-45)
— The Effects of Peak Clipping on Speech Intelligibility 10-26(14-31)
— The Effects of Amplitude Compression on Speech Intelligibility 10-26(31-40)
— *See also* Sung, Jing J.
Speech Recognition System
— Recent Patents: Lawrence Richard Rabiner and Marvin Robert Sambur 10-30(291)
Speech Synthesis *see* Reading Machines; *see also* Synthetic Speech
Speech Synthesizing Apparatus
— Recent Patents: Michael John Underwood, Michael Joseph Martin, and Michael Victor Iles 10-30(291)
Speedo Aqualift Swimsuit, VAPC Research Report 10-25(154-156)
Spinal Column Prosthesis/Orthosis
— Recent Patents: David Warren Lewis and Robert K. Greenlaw 10-30(291)
The Spinal-Cord-Injured Patient Workshop: (i.e., Conference)
— Paul R. Meyer 10-22(513-516)
Spinal-Cord-Injury
— The Clinical Engineer and the Spinal-Cord-Injury Person: Peter C. Hofstra 10-22(37-40)
— Evaluation of Electrical Stimulation as a Treatment for the Re-

duction of Spasticity: Ross Davis and John W. Gesink 10-22(302-309)
— First Aid
— An Occipito-Zygomatic Cervical Orthosis Designed for Emergency Use — A Preliminary Report 10-29(50-64)
— Orthotics, Spinal Cord Injury, and other Severe Disabilities: Eugene F. Murphy 10-22(295-297)
— Transcutaneous Nerve Stimulation for Treatment of Pain in Spinal-Cord-Injured Patients: Ross Davis and Richard Lentini 10-22(298-301)
Spinal Cord Injury Centers
— New Centers for SCI Patients. Notes and News 10-23(353)
— West Roxbury SCI Center to Apply New Care Concepts. Notes and News 10-25(251)
— West Roxbury's New SCI Center is Open. Notes and News 10-30(281)
Spinal Cord Injury Management
— Dr. Marian Weiss Lectures on Management of the Spinal Cord Injured at New York VA. Notes and News 10-22(521)
Spinal-Cord-Injury Studies: Paralysis, Spasticity, and Pain
— Contractor Reports: R.M. Davis. VA Hospital, Miami, Florida 10-21(146-147) J.W. Gesink, M. Rosen, E. Falkenberg, J.D. Jacobi 10-23(328-329) 10-24(250) 10-25(213)
— The Development of Implantable Multi-Lead Stimulations for the Control of Reflex Muscle Functions 10-21(147)
— Electronic Gait Assist Device 10-23(328)
— Evaluation of Transcutaneous Stimulation for the Treatment of Pain in Spinal-Cord-Injured Patients 10-21(146-147)
— The H-Reflex as a Titration Indicator During Phenal Injections 10-23(329)
— Investigation of the Mechanism of Spasticity 10-23(328)
— The Neurophysiological Basis of Spinal Cord Paralysis in Spasticity 10-21(147)
— Publications 10-25(213)
— Wrist Orthosis for Management of Tremor 10-23(328)
Spinal Orthoses
— An Occipito-Zygomatic Cervical Orthosis Designed for Emergency Use — A Preliminary Report. Gustav Rubin, Malcolm Dixon, and Joel Bernknopf 10-29(50-64)
— Orthotics: Gustav Rubin and Malcolm Dixon 10-22(31-32)
— Orthotics Workshop: E.E. Harris
— Cervical Orthoses 10-22(500)
— Cervico-Thoracic Orthoses 10-22(501)
Spolek Craig A.
— A Proposed Technique for the Postoperative Monitoring of Skin

Tension in Below-Knee Amputees: E.M. Burgess, C.A. Spolek, and A. James Moore, Jr. 10-28(4-15)
Springer, Warren P.
— Named Associate Professor by NYU School of Medicine. Notes and News 10-25(247-248)
Stainless Medical Products Co., Santa Ana, California
— Electric Wheelchairs, VAPC Research Report 10-26(225-227) 10-28(112-113)
Stair Climbing Tracked Vehicle
— Recent Patents: Howard Jensen 10-23(360)
Stand-Aid Standing Frame, VAPC Research Report 10-30(133)
Standards
— Design Standards and Test Criteria for Automotive Driving Aids, origin described, VAPC Research Report 10-23(251-253)
— Development of Standards for Van Wheelchair Lifts, VAPC Research Report 10-25(169)
— Standards and Specifications for Lower Limb Prosthetic Assemblies and Components, First Draft Announced, VAPC Research Report 10-27(117)
— Test Standards for Wheelchair Cushions, VAPC Research Report 10-25(171)
— VA Standard Design and Test Criteria for Safety and Quality of Special Automotive Driving Aids (Adaptive Equipment) for Standard Passenger Automobiles (VAPC-A-7505-8) Published in Federal Register 1975 10-25(162-167)
Standers
— Ausmus Moto-Stand 10-28(114)
— Castor Portable Standing Frame for Quadriplegics or Paraplegics (Illust.), VAPC Research Report 10-27(111-113) 10-30(133-134)
— ConVaid Mobile Prone Stander, VAPC Research Report 10-25(156-158)
— Godfrey Standing Aid, VAPC Research Report 10-26(246-248)
— LEVO Stand-Up Wheelchair, VAPC Research Report 10-30(127-128)
— Naval Electronics Laboratory Center Stander, VAPC Research Report 10-23(241)
— PACO (Pivot Ambulating Crutchless Orthosis) *see* Parapodium
— Parapodium for Adult Paraplegics: Martin T. Prast 10-22(391-403)
— Research and Development Project on Advanced Orthotic Devices for Adult Paraplegics. Contractor Reports: M.T. Prast, Prast Associates, Grand Island, New York, and L.E. Carlson, University of Colorado, Boulder, Colorado 10-24(254-256) 10-25(215) 10-26(340-341) 10-27(169-172) 10-28(195) 10-29(132) 10-30(206)
— The PACO (Pivot Ambulating Crutchless Orthosis) Described;

Schematic Drawings 10-27(169-171)
— Stand-Aid Portable Standing Frames (Illust.) 10-30(133, Illust., VAPC Research Report 135-136)
— VAPC Powered Ambulator, VAPC Research Report 10-28(114-115)
Standers *see also* Ambulators; Stand-Up Wheelchairs
Stand-Up Wheelchair
— Naval Electronics Laboratory Center (San Diego, Calif.) Stand-Up Wheelchair, VAPC Research Report 10-24(185-186)
— Recent Patents: Charles M. Weant and Arthur Schwartz 10-22(529)
Stanford University (Children's Hospital), Palo Alto, California
— Seating Systems for Body Support and Prevention of Tissue Trauma. Contractor Reports: I. Perkash (VA Hospital, Palo Alto, California) and W. Motloch (Children's Hospital at Stanford University) 10-30(258-268)
Stanley Silent Swing Door Operator, VAPC Research Report 10-29(82-83)
Staros, Anthony
— ISPO—International Key to the Future in Aiding the Handicapped. Editorial: A. Staros 10-27(1-3)
— Needs of the Veterans Administration: A. Staros 10-22(13-14)
— VAPC Research Reports: Anthony Staros, Director, and Edward Peizer, Assistant Director BPR 10-21 through BPR 10-30
Stasis and Stress
— Transferring Load to Flesh. Part VIII. Stasis and Stress: Leon Bennett 10-23(202-210)
Status of the Johns Hopkins Research Program on Upper-Limb Prosthesis-Orthosis Power and Control System: Woodrow Seamone and Gerhard Schmeisser, Jr. 10-22(237-244)
Steeper "Co Ro" Bed, VAPC Research Report 10-26(247-248)
Stein, R.B.
— Implantable Neural Electrode. Recent Patents 10-28(258)
Stereotoner
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, A. Wood, K. Wiley, and S. Paul (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California)
— Stereotoner 10-23(339-340)
— Stereotoner Activity 10-24(267-268) 10-25(223)
— Clinical Trials of Reading Machines for the Blind. Contractor Reports: J.D. Malamazian and H. Lauer (Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois) 10-21(161-162) 10-23(338-339) 10-24(265-266) 10-25(221-222)

— Development of Correspondence Courses for Personal Reading Aids for the Blind. Contractor Reports: D.W. Hathaway and M. Butow (The Hadley School for the Blind, Winnetka, Illinois) 10-21(162-163)
— The Development of Living Skills by the Handicapped: Robert A. Weisgerber 10-22(436-438)
— The Development of Personal Reading Machines for the Blind: Hans A. Mauch and Glendon C. Smith
— Stereotoner Development 10-22(428-429)
— Stereotoner Evaluation 10-22(429)
— Stereotoner Features 10-22(427-428)
— Evaluation of an Ink Print Reading Aids the Stereotoner. Contractor Reports: R.A. Weisgerber (American Insitutes for Research, Palo Alto, California) 10-23(346-347) 10-25(233-236)
— Instruction In, and Evaluation of Reading Machine Techniques. Contractor Reports: D.W. Hathaway, M. Butow, and R.D. Rouse (The Hadley School for the Blind, Winnetka, Illinois) 10-23(339) 10-24(266-267) 10-25(222-223)
— Mauch Stereotoner: Loyal E. Apple (Western Blind Rehabilitation Center) 10-22(460)
— Mobility and Reading Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports: L.E. Apple, R. Bennett, W. Ekstrom, and D.C. Cooper (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California) 10-21(163-165)
— Research and Development in the Field of Reading Machines for the Blind. Contractor Reports: H.A. Mauch and G.C. Smith (Mauch Laboratories, Dayton, Ohio) 10-24(261-264)
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— New Dimension for Sound: Development of the Stereotoner 10-26(147-148)
— Stereotoner Evaluation Study 10-26(148-154)
— Stereotoner Students, After the Research Project 10-26(154-156)
— Stereotoner: Harvey L. Lauer 10-22(66)
— Teaching the Stereotoner: its Problems and Rewards: Margaret Butow 10-22(433-435)
Stevenson, Dennis Clifford, Turning Bed. Recent Patents 10-30(292)
Stewart, Robert E.
— Appointed Honorary Member of AAOS. Notes and News 10-21(174)
Stim-Tech EPC
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)

Stimulation
— Electrode Implantation in the Human Body: Margaret I. Babb and Anthony M. Dymond 10-23(51-150)
— Stimulating Electrodes 10-23(62-97)
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Role of Peripheral Stimulation 10-26(51)
Story of Richard Kinney, Executive Director of the Hadley School
— Notes and News 10-21(176)
Straightening and Supporting Device for the Spinal Column in the Surgical Treatment of Scoliotic Diseases
— Recent Patents: Erkki Einari Nissinen 10-30(291-292)
Stroer, Ronald H.
— Polysensory Mobility Aids. Recent Patents 10-27(210)
Stromberg Carlson
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Background 10-30(75-77)
Studies of Normal and Abnormal Motion
— Contractor Reports: M.P. Murray. VA Hospital, Wood, Wisconsin 10-29(139-143) 10-30(216-217)
Studies Toward a Practical Computer-Aided Arm Prosthesis System: John Lyman, Amos Freedy, and Moshe Solomonow 10-22(213-225)
A Study of Interface Pressures in the Below-Knee Prosthesis (Physiological Suspension)—an Interim Report: Ernest M. Burgess and A. James Moore 10-28(58-70)
Stump Pathological Conditions
— *see* Amputees; Edema; Ischemia
Stump Socks
— Daw Stump Socks, Machine Wash-and-Dry, VAPC Research Report 10-27(94)
— VAPC Research Report 10-23(259-260) 10-25(172) 10-26(264)
Stump Stress Analysis
— Contractor Reports: Leon Bennett. (New York University, New York, New York) For report on the period covered by BPR 10-21 *see* the article "Transferring Load to Flesh: Part VII. Gel Liner Effects" 10-23(23-53) For report on the period covered by BPR 10-23 *see* "Transferring Load to Flesh: Part VIII. Stasis and Stress," 10-23(202-210). 10-24(217-218) 10-25(182-183) 10-26(275-285) VA Research Center for Prosthetics, New York New York 10-27(126, no report) 10-28(134, no report) 10-29(163)
— Design Considerations for a Flexible Prosthetic Socket 10-26(275-279)
— Discussion of Flexion Characteristics of Composite Reinforced Plastics 10-26(283-284)

— Introduction 10-26(275-276)
— Results with Various Resin/Reinforcement Combinations 10-26(279-283)
Subminiature Insertable Force Transducer
— Recent Patents: James C. Fletcher, Robert H. Silver, Gilbert W. Lewis, Cyril Feldstein, and Edward N. Duran 10-26(376)
Summit Corp., Valparaiso, Florida
— Manufacturer, Pak-A-Rak Rear Bumper Mounted Wheelchair Carrier, VAPC Research Report 10-30(144-145)
Sung, Jing J.
— Compression Amplification and Speech Intelligibility in Noise. Contractor Reports: J.J. Sung (VA Hospital, Pittsburgh, Pa.) 10-27(199) 10-28(240-241) 10-29(185-186)
Sun Industries Curb-Climbing Electric Wheelchair
— VAPC Research Report 10-28(106-109)
Super Voyager II
— VAPC Research Report 10-23(230)
Supplemental Sensory Feedback for the VA/NU Myoelectric Hand. Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case and Charles M. Scott 10-26(170-191)
— *See* "Sensory Feedback" for other entries of this subject and for detailed listing of above article
Support Means for the Even Distribution of Body Pressure
— Recent Patents: Eric Flam 10-23(360)
Surgical Procedures
— Skeletal Extension Development: Criteria for Future Designs: Charles William Hall, P.A. Cox, and William A. Mallow 10-25(69-96)
— Animal Models and Surgical Procedures 10-25(79-81)
Survey of Implanted Electrodes: Michael H. Chase 10-22(259-260)
A Survey of Lower-Limb Amputees: Prostheses, Phantom Sensations, and Psychosocial Aspects: Bernice Kegel, Margaret L. Carpenter, and Ernest M. Burgess 10-27(43-60)
— Materials and Methods of the Survey 10-27(44)
— References 10-27(60)
— Results 10-27(44-60)
— Patient Sample 10-27(44-46)
— Prosthetic Information 10-27(46-53)
— Psychosocial Aspects of Amputation 10-27(53-56)
Suspension
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)

— The I.N.A.I.L. Experience Fitting Upper-Limb Dysmelia Patients with Myoelectric Control. Hannes Schmidl 10-27(17-42)
— Prosthetics Research. Contractor Reports: Robert G. Thompson and Dudley S. Childress (Northwestern University Prosthetics Research Laboratory, Chicago, Illinois)
— Atmospheric Pressure Suspension Sockets 10-23(283-284) 10-27(129) 10-30(177)
— A Search for Better Limbs: Prosthetics Research at Northwestern University. Dudley S. Childress, John N. Billock, and Robert G. Thompson 10-22(200-212)
— Present Objectives 10-22(202-206)
— A Study of Interface Pressures in the Below-Knee Prosthesis (Physiological Suspension: An Interim Report) E.M. Burgess and A.J. Moore 10-28(58-70)
Swedish Laser Cane
— The FOA Swedish Laser Cane: Leicester W. Farmer 10-30(105)
Swimming Suits
— Speedo Aqualift Swimsuit, VAPC Research Report 10-25(154-156)
Sydnor Hydro-dynamics, Inc., Richmond, Virginia
— Manufacturer, Sydnor Feeder 10-26(261-262)
Symes Ankle Joint
— Recent Patents: Denis Ronald William May 10-24(286)
SynAir, Tustin, California
— BykFil Rubber Compound for Wheelchair Tires, VAPC Research Report 10-25(150-151)
Synergetic Hook and Hand
— Prosthetics Research. Contractor Reports: Robert G. Thompson and Dudley S. Childress (Northwestern University, Chicago, Illinois)
— Powered Hook-Hand 10-21(121) 10-23(282-284) 10-24(218-219) 10-25(183-184) 10-26(285)
— Synergetic Hook and Hand 10-21(121) 10-27(127-128) 10-28(136)
— Synergetic Hook Modifications 10-30(176)
— Synergetic Hook Preliminary Evaluation 10-28(136) 10-29(100)
Synergy-Pattern-Recognition Concept
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Introduction 10-30(9-10)
Synthetic Skin *see* Cosmetic Coverings for Prostheses
Synthetic Speech
— A Description of the Kurzweil Reading Machine and a Status

Report on its Testing and Dissemination: Aaron Kleiner and Raymond C. Kurzweil 10-27(72-81)
— Speech Generation 10-27(76-77)
— Research on Audible Outputs of Reading Machines for the Blind. Contractor Reports: F.S. Cooper, J.H. Gaitenby, I.G. Mattingly, P.W. Nye, G.N. Sholes (Haskins Laboratories, New Haven, Connecticut) 10-21(153-158) A.M. Liberman 10-23(331-335) 10-24(256-261) 10-25(216-218) F. Ingemann, L. Shockey 10-26(345-348) 10-27(185-187) A. Levitt 10-28(225-228) 10-29(173-178) 10-30(273-275)
— Comparisons of Synthetic Speech Intelligibility 10-23(333-334)
— Development of New Synthesis Methods 10-24(257-258)
— Development of Rules with the FOVE Program 10-27(185) 10-28(225-226)
— Direct Synthesis 10-29(174) 10-30(274)
— Extending the Speech Synthesis Program 10-25(217)
— A Flexible Software Synthesizer 10-25(217)
— Improving Current Synthetic Speech Programs 10-24(256-261)
— Listener Comprehension on Easy Versus Difficult Texts 10-24(258-259)
— New Synthesis Methods 10-25(218)
— Print-to-Sound Conversion for *Surnames* 10-26(345-346)
— Print-to-Sound Rules for Proper Names 10-25(217-218)
— Research Synthesis by Rule 10-27(186) 10-28(226) 10-29(175) 10-30(275)
— Revisions to the Synthesis Programs 10-26(345)
— Rules Development 10-29(175)
— Rules for the OVE Synthesizer 10-21(157-158)
— Segmental Cues 10-27(187) 10-28(227-228) 10-29(176-178)
— Software Synthesizer 10-29(173-174)
— Studies of Temporal Variation in Natural Speech 10-26(347)
— Synthesis From Typesetter's Tapes 10-21(156-157)
— Synthesis Playback 10-29(173)
— Synthetic Speech Comprehension 10-23(334-335)
— Synthetic Speech Evaluation 10-21(154-156)
— Synthetic Speech Improvements 10-23(332-333)
— Temporal Patterns of Syllables 10-29(175-176)
— Temporal Variation and Speech Synthesis 10-27(186) 10-28(226-227)
— Research and Development in the Field of Reading Machines for the Blind: Glendon C. Smith and Hans A. Mauch 10-27(61-71)
— Future Work 10-27(69-71)
— Synthetic Speech Production. Contractor Reports: H.A. Mauch and G.C. Smith (Mauch Laboratories, Dayton, Ohio) 10-26(350)

Synthetic Speech *see also* Reading Machines
System for Operating a Prosthetic Limb
— Recent Patents: Eduard Horvath 10-23(360)
A System to Provide Physiologic Sensation From an Upper-Limb Amputation Prosthesis
— Contractor Reports: F.W. Clippinger, Jr. Duke University Medical Center, Durham, North Carolina 10-21(141 no report) 10-22(247-257) 10-23(315 no report)

T

Tactile Aids (Reading)
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— A Tactile Aid Evaluated 10-26(146)
— *See also* Visotactor, Optacon
Tactile Sensing Means for Prosthetic Limbs
— Recent Patents: Walter L. Scott 10-21(179)
Tactile Sensory Aids (General Clinical Applications Methodology) *see also* Electro-tactile Sensory Aids (UCLA)
The Tactile Vision Substitution System
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Experimental Devices 10-30(108-111)
Tarvin, Ronald L.
— Method and Apparatus for Programming a Computer Operated Robot Arm. Recent Patents 10-26(376)
Taw, Harry
— Photocurable Contour Conforming Splint. Recent Patents 10-29(195-196)
Taylor, Donald R.
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor and F. Ray Finley 10-30(8-35)
Teaching the Stereotoner: its Problems and Rewards: Margaret Butow 10-22(433-435)
Technical Aids for the Speech-Impaired
— Notes and News 10-24(279)
Technology Transfer
— Editorial: Eugene F. Murphy 10-29(1-7)
Technology Utilization Program, VAPC Research Report 10-23(263-264)
Telecommunications System for the Hearing Impaired Utilizing Baudot-ASCII Code Selection

— Recent Patents: Reynold Sachs and Frank Cicchiello 10-25(258)
Telephone Devices
— *See* VAPC Research Reports—Spinal Cord Injury Rehabilitation-Communication Aids; also Environmental Control and Communication Devices
Telescoping Cane
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Folding or Collapsible Canes 10-30(50-54)
Telescopic Mouth Instrument
— VAPC Research Report 10-21(93-94)
Telescopic (i.e. 2-piece) Mouthstick as Used with Wheelchair Chin Controller and Manipulator/Worktable
— Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prostheses and Orthoses. Contractor Reports: Johns Hopkins University 10-24(229-230) 10-25(201-202) 10-26(308-311) 10-28(158-160) 10-29(111-114) 10-30(186-188)
Telescopic Stick for Paralytics
— Recent Patents: Arthur J. Cloran 10-22(529)
Temple University
— The First International Symposium On Facial Prosthetics, Arnhem, the Netherlands, April 19-23, 1976: John F. Lontz 10-25(129-133)
Temple University, Medical Research and Training Center, Philadelphia, Pennsylvania *see* Gunilla Wannstedt and Rebecca Craik
Temple University — Moss Rehabilitation Hospital
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Introduction 10-30(9-10)
Temple University School of Dentistry, Philadelphia, Pennsylvania
— Current Status — Prosthetic Materials for Maxillofacial Reconstruction: James W. Schweiger and John F. Lontz 10-22(408-409)
— Maxillofacial Restorative Materials and Techniques. Contractor Reports: J. W. Schweiger and John F. Lontz 10-21(143-145) 10-23(319-321) 10-24(241-243) 10-25(210-211) 10-26(323-330) 10-27(161-165) 10-28(182-188) 10-29(145-154) 10-30(223-248)
Temporary Orthoses
— Konvalin Adjustable KAFO and AFO, VAPC Research Report 10-23(225-226)
Tendon
— Skeletal Extension Development: Criteria for Future Designs: Charles William Hall, P.A. Cox, and William A. Mallow 10-25(69-96)
— Artificial Tendon 10-25(76-79)
Tension
— A Device Designed to Approximate Shear Forces On Human Skin

(A Preliminary Study): David W. Lewis and William B. Nourse 10-30(36-46)
— Editor's Note 10-30(36-37)
— A Proposed Technique for the Postoperative Monitoring of Skin Tension in Below-Knee Amputees. E.M. Burgess, C.A. Spolek, and A.J. Moore 10-28(4-15)
Terekhov, Yurig V.
— Device for the Determination and the Automatic Real-Time Computation of the Parameters of Man's Stability of Stance. Recent Patents 10-25(257)
Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl. P. Mason 10-25(38-54)
— Characteristics of Nerve Transmissions 10-25(42-43)
— Preliminary Tests 10-25(43-49)
— Electrode Interface Variations 10-25(49)
— Resistive Load Variations 10-25(48-49)
— Test Conditions 10-25(43)
— Test Results 10-25(44-47)
— Mentor 401 10-25(44-45)
— Neuromod TNS 10-25(45)
— Neuropac II 10-25(46)
— Stim-Tech EPC 10-25(47-48)
— Theories on the Transmission of Pain 10-25(41-42)
Test Standards for Wheelchair Cushions, VAPC Research Report 10-24(200) 10-25(171) 10-26(263-264)
Test Standards *see also* Standards
Texas A&M University, College of Engineering, College Station, Texas
— Development and Evaluation of Advanced Automotive Adaptive Equipment. Contractor Reports: M. McDermott, Jr., and L.A. Leavitt 10-25(205-206) 10-26(317-320) 10-27(149-154)
— The Improvement of Assistive Systems Through Research, Design, Clinical Testing and Team Evaluation. Contractor Reports: P.H. Newell, Jr., and L.A. Leavitt 10-21(138-139) 10-23(312)
— The Improvement of Prosthetic and Orthotic Devices Through Materials Research, Analysis, Design, Clinical Testing, and Team Evaluation. Contractor Reports: M. McDermott and L.A. Leavitt 10-24(235-236)
— Safety During Mobility: Make McDermott, Jr., Paul H. Newell, Jr., and Lewis A. Leavitt 10-22(388-390)
Texas Institute of Rehabilitation and Research (TIRR)
— TIRR Device Wins Award. Notes and News 10-23(353)
Texas Society Honors a Biomedical Engineer
— Notes and News 10-25(246)

Texture
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Texture Gradients 10-26(71-72)
Theories on the Transmission of Pain
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
Theradyne Corp.; Jordan, Minn.
— Theradyne Electromatic Wheelchair, VAPC Research Report 10-21(106)
— Theradyne Marquis Wheelchair, VAPC Report, 10-21(106)
Therapeutic Wheelchair Rocker
— VAPC Research Report 10-25(158-159)
Thermal Flare
— Thermographical Investigation of Decubitus Ulcers: Richard S. Trandel, David W. Lewis, and Phyllis J. Verhonick 10-24(137-155)
— Conclusions 10-24(153-154)
Thermal Mottling
— Thermographical Investigation of Decubitus Ulcers: Richard S. Trandel, David W. Lewis, and Phyllis J. Verhonick 10-24(137-155)
— Conclusions 10-24(153-154)
Thermographical Investigation of Decubitus Ulcers: Richard S. Trandel, David W. Lewis, and Phyllis J. Verhonick 10-24(137-155)
— Effects of Pressure on Tissue 10-24(140-142)
Thermography *see*; Skin Blood Flow, Thermographical
Thomas, Dale H.
— Invalid Lifting and Walking Device. Recent Patents 10-27(209)
Thomas, Morton I.
— Quad (Four Footed) Cane. Recent Patents 10-30(290)
Thompson, Herbert
— Artificial Limb With Three-Part Cosmetic Covering. Recent Patents 10-28(257)
Thompson, Robert G.
— Prosthetics Research. Contractor Reports: R.G. Thompson, and D.S. Childress (Northwestern University, Chicago, Illinois) 10-23(282-284) 10-24(218-219) 10-25(183-184) 10-26(285) 10-27(127-129) 10-28(135-138) 10-29(100-103) 10-30(176-178)
— A Search for Better Limbs: Prosthetics Research at Northwestern University: D.S. Childress, J.N. Billock, and R.G. Thompson 10-22(200-212)
Thornton, Walter
— Mobility Devices: Leicester W. Farmer 10-30(47-118)

— Conclusion — ETA's 10-30(111-112)
Three-Wheel Vehicles
— Tri-Wheeler, Braun Corp., Winamac, Indiana, VAPC Research Report 10-25(151)
Threshold Selection
— Pattern-Recognition Arm Prosthesis: A Historical Perspective — A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Data Treatment and Analysis 10-30(13-19)
Threshold Technology, Cinnaminson, New Jersey
— Voice Recognition System, VAPC Research Report 10-23(248)
Threshold Technology, Inc., Delran, New Jersey
— Manufacturer, VIP — 100 Speech Recognition Environmental Control System, VAPC Research Report 10-28(96)
Tie-Down for Wheelchair-Riding Van Passengers, VAPC Research Report 10-23(255-257)
TIRR *see* Texas Institute of Rehabilitation and Research
Titus, Bert R.
— A Sensory Feedback System for an Upper-Limb Amputation Prosthesis: F.W. Clippinger, R. Avery, and B.R. Titus 10-22(247-258)
Toe-Actuated Control System
— Control of Upper Limb Prostheses in Several Degrees of Freedom: Daniel Graupe
— Introduction 10-22(226)
— Toe-Actuated Control 10-22(227-228)
— A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals: Daniel Graupe
— Prosthesis Interface Schematic 10-27(13)
— Conclusions 10-27(15)
Toe Break
— Physical Response of SACH Feet Under Laboratory Testing: R.L. Daher 10-23(4-50)
Tomatis, Alfred A.A.
— Electronic Hearing Apparatus. Recent Patents 10-28(257)
The Torch
— Mobility Devices; Leicester W. Farmer 10-30(47-118)
— The Torch 10-30(97-98)
Torfason, L.E.
— Computer Optimization of Polycentric Prosthetic Knee Mechanisms: D.A. Hobson and L.E. Torfason 10-23(187-201)
Torque Absorber
— Shank Torque Absorber. Contractor Reports: C.W. Radcliffe, D.M. Cunningham, and J.M. Morris (University of California, Berkeley, California) 10-21(124)

Torque Absorbers *see also* Rotators
Touch-Operated Selector Control (TOSC)
— VAPC Research Report 10-26(220-222) 10/27(96-97)
Tracking Aids *see* Reading Aids for the Blind (Butow, Mauch)
Training
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
— Prosthetic Training 10-24(76-79)
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Perceptual Learning and Visual Training 10-26(57-58)
— Training Suggestions for the Adventitiously Visually Impaired Person 10-26(70-74)
Trainor, Frieda S.
— Hemodynamic Evaluation of Postoperative and Preoperative Amputees. Contractor Reports: B.Y. Lee, F.S. Trainor, J.L. Madden, and E. Ejercito (VA Hospital, Castle Point, N.Y.) 10-21(142-143) D. Kavner 10-25(210-211) 10-26(322-323) 10-27(158-161) 10-28(180-181) 10-29(125-127) 10-30(199-200)
Trandel, Richard S.
— Thermographical Investigation of Decubitus Ulcers: R.S. Trandel, D.W. Lewis, and P.J. Verhonick 10-24(137-155)
Transcutaneous Nerve Stimulation (TNS)
— Evaluation of Transcutaneous Stimulation for the Treatment of Pain in Spinal-Cord-Injured Patients. Contractor Reports; R.M. Davis (VA Hospital, Miami, Florida) 10-21(146-147)
— Transcutaneous Nerve Stimulation for Treatment of Pain in Spinal-Cord-Injured Patients: Ross Davis and Richard Lentini 10-22(298-301)
Transcutaneous Nerve Stimulator
— Recent Patients: Curtis H. Miller 10-30(292)
Transcutaneous Stimulators
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
Transducers *see* Fluidics, Force, Gages, Hemodynamics, Loading, Pressure, Shear
Transferring Load to Flesh: Leon Bennett 10-22(133-143)
Transferring Load to Flesh—Part VII. Gel Liner Effects: Leon Bennett 10-21(23-53)
Transferring Load to Flesh. Part VIII. Stasis and Stress. Leon Bennett 10-23(202-210)
—*See also* "Stump Stress Analysis"
Travel Aids for the Blind *see* Mobility Aids for the Blind

Travel Vision
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Introduction 10-26(49-50)
Trends in Nonlicensed Mobility Aids: Ronald Lipskin 10-22(41-52)
Tri-Pin Quad Steering Device No. 3522 (Automotive Driving Aid)
— VAPC Research Report 10-26(259)
Triple-Control System
— The Lift Lock: A Device to Increase the Lifting Ability of Dual-Control Prostheses: Lawrence E. Carlson and Dudley S. Childress 10-23(158-168)
— Alternative Harness Patterns 10-23(162)
Tripod Canes
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Support or Orthopedic Canes and Crutches 10-30(56-70)
Tri-Wheeler
— VAPC Research Report 10-25(151)
Trumpler, Theodor
— Leg Prosthesis with Resiliently Mounted Stump Socket. Recent Patents 10-21(178)
Tubular-Pylon Couplings
— Design of Prosthetic and Orthotic Devices. Contractor Reports: Charles W. Radcliffe, Don M. Cunningham, and James M. Morris (University of California, Berkeley, California)
— Internal-Expanding Foot-to-Pylon Coupling 10-25(195)
— Modular Pylon Structure for Below-Knee Prostheses 10-28(146)
— Tube Couplings for Modular Prostheses 10-21(124-125) 10-23(286) 10-27(133) 10-28(144-146)
Tucker, Robert
— Prosthetic Foot. Recent Patents 10-30(290)
Tufts Interactive Communicator, VAPC Research Report 10-23(248-249)
— Compared with PortaPrinter 10-25(144-145)
Turning Bed
— Recent Patents: David John Willis, Dennis Clifford Stevenson, and William Bettle 10-30(292)
Twenty-Four Volt Everest & Jennings Electric Wheelchair, VAPC Research Report 10-21(98-99)
Twenty-Five Years of Progress: (The VA Prosthetics Research and Development Program) Monroe J. Gershenson and Wilfred G. Holsberg 10-21(3-8)
Typhlocane
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Long Cane 10-30(48)

U

UC-BL Four-Bar Polycentric Knee
— VAPC Research Report 10-27(94)
UC-BL Pneumatic Swing Control Unit
— VAPC Research Report 10-23(222)
UC-BL Torque Absorber
— VAPC Research Report 10-23(219-220)
UC-BL *see also* University of California, Berkeley
Ultralight Below-Knee Prosthesis
— Contractor Reports: A. Bennett Wilson, Jr., Moss Rehabilitation Hospital, Rehabilitation Engineering Center, Philadelphia, Pennsylvania 10-27(176-179) 10-28(218-219) 10-29(122-123) C.M. Pritham 10-30(196-197)
Underwood, Michael John
— Speech Synthesizing Apparatus. Recent Patents 10-30(291)
United Nations to Proclaim the Year 1981 "International Year for Disabled Persons"
— Notes and News 10-27(205)
United States Army Signal Corps
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Aids Using Optical Principles 10-30(87-108)
— United States Army Signal Corps Obstacle Detector 10-30(87-88)
Universal Wheelchair for the Severely Disabled
— Recent Patents: David M. Anderson 10-24(286)
Universal Wrist System
— Recent Patents: Wesley C. Prout 10-22(529)
Universally Movable Ankle Joint for Tube Skeleton Artificial Limbs
— Recent Patents: Klaus Prahl 10-24(286)
University of California, Berkeley, California
— Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion. Contractor Reports: C.W. Radcliffe, H.D. Eberhart, D.M. Cunningham and J.M. Morris 10-21(123-126) 10-23(285-290) 10-24(220-222) 10-25(194-198) 10-26(288-301) 10-27(129-136) Larry Lamoreux 10-28(142-152) 10-29(120-121) 10-30(193-196)
— Locomotion and Lower-Limb Prosthetics: Charles W. Radcliffe 10-22(167-187)
— Variable-Height-Powered Wheelchair for the Quadriplegic Driver: Don M. Cunningham 10-22(337-369)
— *see also* Wheelchairs
University of California, Los Angeles, Calif.
— Clinical Application of Electrode Implantation in the Human Body. Contractor Reports: University of California, Brain Infor-

mation Service, Center for Health Sciences; M.H. Chase and M. Babb 10-21(147-148)

— Fundamental and Applied Research Related to the Design and Development of Upper-Extremity Externally Powered Prostheses. Contractor Reports: J.H. Lyman, Amos Freedy, and Ronald Prior 10-21(122-123) 10-23(284-285) 10-24(219-220) 10-25(184-194) 10-26(286-288) M. Solomonow 10-27(129-132) 10-28(139-141) 10-29(104-106) 10-30(179-182)

University of Canterbury, Christchurch, New Zealand

— Mobility Devices: Leicester W. Farmer 10-30(47-118)

— The Sonicguide 10-30(97)

University of Colorado, Boulder, Colorado

— Position Control of Above-Elbow Prostheses. Contractor Reports: L.E. Carlson 10-29(108-109) 10-30(184)

— Research and Development Project on Advanced Orthotic Devices for Adult Paraplegics. Contractor Reports: Martin A. Prast (Prast Research Associates) and Lawrence E. Carlson (University of Colorado) 10-25(215) 10-26(340-341) 10-27(169-172) 10-28(195) 10-29(132, no report) 10-30(206)

University of Maryland, College Park, Maryland

— Development of a Hearing-Aid System with Independently Adjustable Subranges of its Spectrum Using Microprocessor Hardware. Contractor Reports: Daniel Graupe (Colorado State University, Fort Collins, Colorado) 10-23(351-352) 10-24(274-275) 10-25(241-242) 10-26(363-364) and G.D. Causey (University of Maryland, and VA Hospital, Washington, D.C.) 10-27(199-200) 10-28(241-242) 10-29(178) 10-30(275-276)

— The Development of Improved Techniques for the Analysis of Hearing-Aid Performance. Contractor Reports: G.D. Causey, J. Punch, H.C. Schweitzer, Earleen Elkins and L. Beck (University of Maryland and VA Hospital, Washington, D.C.) 10-23(342-346) 10-24(269) 10-25(231-233) 10-26(357-360) 10-27(191-196) 10-28(235-238) 10-29(179-184) 10-30(276-278)

— Influence of Input and Gain Values Upon Electroacoustic Properties of Hearing Aids. Contractor Reports: G.D. Causey, E. Elkins, and L.B. Beck 10-21(166-167)

University of Miami, Miami, Florida

— Development of Refined Fitting Procedures for Lower-Limb Prostheses—Case Studies of Applied Research in Orthotics and Prosthetics—A Final Report. Contractor Reports: A. Sarmiento, N.C. McCollough, III, L.L. Latta, and F.R. Hampton 10-21(136-137) 10-23(310-312) 10-24(234-235) 10-25(204) 10-26(316-317) 10-28(162-178)

University of Southern California, Los Angeles, California

— VAPC Contractor to Develop Electronic Physiological Geriatric

Monitor, VAPC Contractual Development Program 10-24(208)
University of Virginia, Department of Mechanical and Aerospace Engineering, Charlottesville, Virginia 22901
— *see* David W. Lewis
University of Virginia, School of Nursing, Charlottesville, Virginia 22901
— *see* Phyllis J. Verhonick
University *see also* Case Western Reserve, Colorado State, Duke, Johns Hopkins, New York, Northwestern, Temple, Texas A&M
Upper-Limb Components
— VAPC Research Report 10-23(260) 10-24(201) 10-25(171) 10-26(264)
— *see also* VAPC Research Report—Prosthetics-Upper Limb, VAPC Research Reports; Testing (Compliance)
Upper-Limb Orthoses
— Electrocutaneous Feedback for Artificial Limbs. Summary Progress Report. February 1, 1974, Through July 31, 1975: Ronald E. Prior and John Lyman 10-24(3-37)
— A Five-Year Review of Clinical Experience with Johns Hopkins University Externally Powered Upper-Limb Prostheses and Orthoses: Gerhard Schmeisser, Jr., and Woodrow Seamone 10-23(211-217)
— Immediate Postoperative Application of Upper-Limb Orthoses: Charles L. McDowell 10-22(404-405)
— Immediate Postoperative Application of Upper-Limb Orthoses. Contractor Reports: C.L. McDowell (VA Hospital, Richmond, Virginia) 10-21(137-138) 10-23(311, no report)
— Patient Evaluation of a Functional Electrical Stimulation Hand Orthosis. Contractor Reports: P.H. Peckham (VA Hospital, Wade Park, Cleveland, Ohio) 10-26(344) 10-27(174-176) 10-28(214-218) 10-29(130-132) 10-30(201-203)
— Status of the Johns Hopkins Research Program on Upper-Limb Prosthesis-Orthosis Power and Control System: Woodrow Seamone and Gerhard Schmeisser, Jr. 10-22(237-244)
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand. Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case and Charles M. Scott 10-26(170-191)
— Introduction 10-26(170-171)
Upper-Limb Orthoses *see also* Elbow Orthoses, Externally Powered Orthoses, Hand Orthoses, etc.
Upper-Limb Orthotics
— Orthotics Workshop: E.E. Harris
— Upper Limb 10-22(501-502)
— Orthotics: Gustav Rubin and Malcolm Dixon 10-22(33-36)
Upper-Limb Prostheses

— Control of an Artificial Upper Limb in Several Degrees of Freedom. Contractor Reports: D. Graupe (Colorado State University, Fort Collins, Colorado) 10-21(139-141) 10-22(226-236) 10-23(312-315) 10-24(236-238) 10-25(206-207) 10-26(320-322) 10-27(155-157) 10-28(178-179) 10-29(107-108) 10-30(182-183)
— Electrocutaneous Feedback for Artificial Limbs. Summary Progress Report. February 1, 1974, Through July 31, 1975: Ronald E. Prior and John Lyman 10-24(33-37)
— A Multifunctional Prosthesis Control System Based on Time Series Identification of EMG Signals Using Microprocessors: Daniel Graupe, Alosius A.M. Beex, William J. Monlux, and Ian Magnussen 10-27(4-16)
— Proportionally Controlled Linear Power Assist Device for Artificial Arms: Ronald E. Prior and Charles M. Scott 10-24(43-50)
— A Search for Better Limbs: Prosthetic Research at Northwestern University: Dudley S. Childress, John N. Billock, and Robert G. Thompson 10-22(200-212)
— High Performance and Reliable Mechanisms 10-22(208-211)
— Myo-pulse Modulation 10-22(208-210)
— Synergetic Prehension 10-22(210-211)
— Improvement of Existing Prosthetic Approaches 10-22(205-208)
— Glenohumeral Joint 10-22(207-208)
— Harness for the Above-Elbow Amputee 10-22(205-206)
— Lift-Lock Mechanism 10-22(206-207)
— Self-Contained and Self-Suspended Devices 10-22(204)
— Subconscious Control 10-22(202-204)
— A Sensory Feedback System for an Upper-Limb Amputation Prosthesis: Frank W. Clippinger, Roger Avery, and Bert R. Titus 10-22(247-258)
— Status of the Johns Hopkins Research Program on Upper-Limb Prosthesis-Orthosis Power and Control System: Woodrow Seamone and Gerhard Schmeisser, Jr. 10-22(237-244)
— Studies Toward a Practical Computer-Aided Arm Prosthesis System: John Lyman, Amos Freedy, and Moshe Solomonow 10-22(213-225)
— A Versatile Joint Rotation Device for Externally Energized Upper-Limb Prostheses: Paul Meadows and John Lyman 10-24(38-42)

Upper-Limb Prosthetics

— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)

— A Five-Year Review of Clinical Experience with Johns Hopkins University Externally Powered Upper-Limb Prostheses and Orthoses: Gerhard Schmeisser, Jr., and Woodrow Seamone 10-23(211-217)
— Fundamental and Applied Research Related to the Design and Development of Upper-Limb Externally Powered Prostheses. Contractor Reports: John H. Lyman, Amos Freedy, Ronald Prior, and Moshe Solomonow (University of California, Los Angeles)
— Control of an Artificial Limb with Several Degrees of Freedom of Motion 10-27(129-130) 10-28(139-140)
— Electromyographic Pattern Control Arm Prostheses 10-21(123) 10-24(220) 10-25(188-193) 10-26(286)
— Microcomputer-Aided Upper Limb Prostheses 10-21(123) 10-23(284-285) 10-24(219-220) 10-26(286-287) 10-27(129-130) 10-28(139-140)
— Myoelectrically Controlled Upper Limb Prostheses 10-23(284) 10-24(219) 10-25(184-193) 10-27(131-132) 10-28(139)
— Sensory Feedback Studies of Upper Limb Prostheses 10-21(122-123) 10-23(284) 10-24(220) 10-25(193-194) 10-26(287-288) 10-28(140)
— The VA/UCLA Four-Degree-of-Freedom Arm Prostheses 10-25(188-193)
— The VA/UCLA Three-Degree-of-Freedom Arm Prostheses 10-25(187-188) 10-26(286-287) 10-27(129-131) 10-28(139)
— The VA/UCLA Two-Degree-of-Freedom Arm Prostheses 10-25(185-187)
— Pattern-Recognition Arm Prosthesis: A Historical Perspective—A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Prosthetics Research. Contractor Reports: Robert G. Thompson and Dudley S. Childress (Northwestern University, Chicago, Illinois)
— Above-Elbow Prosthesis Control 10-27(128)
— Atmospheric Pressure Suspension System 10-27(129) 10-30(177)
— Design of a Powered Arm for Shoulder Disarticulation Amputees 10-26(285) 10-28(135) 10-29(100-101) 10-30(176-177)
— Northwestern University Below-Elbow Socket 10-27(129) 10-28(136)
— Powered Hand-Hook 10-21(121) 10-23(282-284) 10-24(218-219) 10-25(183-184) 10-26(285)
— Thoracic Suspension Harness 10-21(122) 10-27(129)
— *see also* Myoelectric Control, Synergetic Hook
— VA Prosthetics Center Research, Development, and Evaluation

Program: Edward Peizer
— The Johns Hopkins Applied Physics Laboratory Prosthesis 10-22(473)
— VAPC Free-Swing Electric Elbow 10-22(472-473)
— VAPC Hand 10-22(473)
— VAPC Hook 10-22(473)
Upper-Limb Prosthetics Workshop: John H. Lyman 10-22(503-508)
— Overall Evaluation of Workshop Effort 10-22(508)
— Recommendations 10-22(503-508)
— Advanced Work on External Energy Systems 10-22(507-508)
— Component Development 10-22(505-506)
— Coordinated Control 10-22(504-505)
— Cosmesis 10-22(504)
— Education 10-22(503-504)
— Maintenance and Service 10-22(506)
— Specialized Centers 10-22(505)
— Voice Control 10-22(505)
Upper Limb-Prosthetics *see also* VAPC Research Reports — Prosthetics — Upper Limb, VAPC Research Reports, Testing (Compliance)
Urban, Ted F.
— Crutch Tip With Insert. Recent Patents 10-21(177)
Urethane Foam
— Cosmetic Shank Cover, VAPC Research Report 10-21(73)
Urinal Bag
— Urinal Bag Clamp. Contractor Reports: C.W. Radcliffe, D.M. Cunningham, J.M. Morris, and L. Lamoreux (University of California, Berkeley, California) 10-27(136) 10-28(151-152) 10-29(122)
U.S. Manufacturing Co., Glendale, Calif.
— Four-Bar Linkage Knee, VAPC Research Report 10-29(80)
— Marketer of Jouk Standing Ambulator, VAPC Research Report 10-26(241-242)
— Spring Controls for Multiplex Above-Knee Endoskeletal Structures, VAPC Research Report 10-26(217-218)
— VAPC Contractor to Redesign SACH Foot for Special Applications, VAPC Contractual Development Program, VAPC Research Report 10-24(208)
U.S. Office of Education
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Stereotoner Evaluation Study 10-26(148-154)
Uveitis
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Candidate Requirements 10-30(80)

V

VA Amputee Treatment Center, Denver, Colorado
— New VA Amputee Treatment Center Opens in Denver. Notes and News 10-22(521)
VA Center, Wood, Wisconsin
— Studies of Normal and Abnormal Motion. Contractor Reports: Mary Patricia Murray 10-29(139-144) 10-30(216-217)
VA Conference of Prosthetics and Sensory Aids Research Project Leaders, July 20-23, 1974, Rehabilitation Insitute of Chicago 10-22(1-520)
VA Coordinating Committee on Blind Rehabilitation Held First Meeting March 27, 1978
— Notes and News 10-30(282)
VA Elbow
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara R. Sowell, and Vern L. Houston 10-24(51-136)
Vacuum-Formed Lower-Limb Polypropylene Orthoses, VAPC Research Report 10-23(225)
Vacuum-Forming
— Ankle-Foot Orthosis (Polypropylene) VAPC Research Report 10-21(77)
— Plastic Lower-Limb Sockets, VAPC Research Report 10-21(72)
— Vacuum-Formed Lower-Limb Orthoses (Polypropylene) VAPC Research Report 10-23(225)
Vacuum Thermoformed Polyethylene Shell
— Pattern-Recognition Arm Prosthesis: A Historical Perspective— A Final Report: Roy W. Wirta, Donald R. Taylor, and F. Ray Finley 10-30(8-35)
— Electrodes and Electrode Support 10-30(23-25)
VA Hand
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
VA Hospital, Castle Point, New York
— Acceleration of Bone Healing by Electrical Stimulation. Contractor Reports: G.V.B. Cochran 10-27(157-158) Project Transferred to Helen Hayes Hospital, West Haverstraw, N.Y.
— Clinical and Physiological Evaluation of Seat Cushions for the Paralyzed. Contractor Reports: Bok Y. Lee (VA Hospital, Castle Point, N.Y.) and Leon Bennett (VAPC) 10-29(160-161) 10-30(258)
— Hemodynamic Evaluation of Postoperative and Preoperative Amputees. Contractor Reports: B.Y. Lee, F.S. Trainor, D.

Kavner, J.L. Madden, and E. Ejercito 10-21(142-143) 10-23(318-319) 10-24(239-240) 10-25(209-210) 10-26(322-323) 10-27(158-161) 10-28(180-181) 10-29(125-127) 10-30(199-201)

VA Hospital, Cleveland, Ohio

— The Current Status of and Future Considerations for Environmental Control Systems: Robert Green 10-22(310-325)

— Engineering Applications in Orthotic and Prosthetic Treatment of Musculoskeletal Defects. Contractor Reports: E. Byron Marsolais, A.H. Burstein, and E. Schulz 10-26(341-344) 10-27(172-174) 10-28(195-214) 10-29(127-129) 10-30(201)

— Patient Evaluation of a Functional Electrical Stimulation Hand Orthosis. Contractor Reports: P.H. Peckham 10-26(344) 10-27(174-176) 10-28(214-218) 10-29(130-131) 10-30(201-203)

VA Hospital, Gainesville, Florida

— Development and Evaluation of a New Artificial Larynx. Contractor Reports: L. Goldstein, H. Rothman, and C. Oliver 10-29(186) 10-30(276-279)

VA Hospital, Hines, Illinois. Central Rehabilitation Section for Visually Impaired and Blinded Veterans

— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: J.D. Malamazian, H. Lauer, and J.J. Whitehead 10-23(337-338) 10-24(264-265) L.W. Farmer 10-25(219-221) 10-26(350-352) 10-27(187-190) 10-28(230-232) 10-29(167-169) 10-30(268-270)

— Clinical Trials of Reading Machines for the Blind. Contractor Reports: J.D. Malamazian and H. Lauer 10-21(161-162) 10-23(338-339) 10-24(265-266) 10-25(221-222) 10-26(353-354) 10-27(190-191) 10-28(229-230) 10-29(170) 10-30(270-272)

— Current State of the Research Effort at Veterans Administration, Hines, Illinois: John D. Malamazian and Harvey Lauer 10-22(451-457)

— Mobility Devices: Leicester W. Farmer 10-30(47-118)

— Reading and Mobility Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports: J.D. Malamazian, L.W. Farmer, and J.J. Whitehead 10-21(160-161)

VA Hospital, Los Angeles, California

— Functional Neuromuscular Stimulation of Limbs: A Feasibility Study, Contractor Reports: J.A. Foster, and M. Solomonow 10-30(203-206)

VA Hospital, Miami, Florida

— Spinal-Cord-Injury Studies: Paralysis, Spasticity, and Pain. Contractor Reports: J.W. Gesink M. Rosen, E. Falkenberg, and J.D. Jacobi 10-21(146-147) 10-23(328-329) 10-24(250) 10-25(213)

VA Hospital, Nashville, Tennessee

— Electrophysiological Techniques in Evaluation and Correction of Neuromuscular Defects. Contractor Reports: Paul P. Griffin and Richard G. Shiavi 10-29(144) Sherry Champion and Frank Freeman 10-30(217-223)

VA Hospital, New Orleans, Louisiana

— Orthopedic Implant Device Retrieval and Analysis. Contractor Reports: Allan M. Weinstein 10-27(179-180) 10-28(219-224) 10-29(138) 10-30(215-216)

VA Hospital, Palo Alto, California, Western Blind Rehabilitation Center

— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: Richard Bennett, Nancy Darling, Alan Frost, Gregory L. Goodrich, Rex Ward, and Alice Wood 10-23(339-341) Kenneth Wiley 10-24(267-268) 10-25(223-226) 10-26(354-356) 10-27(No report; the period is covered in an article, "A Preliminary Followup Study of Electronic Travel Aid Users") 10-27(82-91) H. Stanton Paul 10-28(232-235) 10-29(171-172) 10-30(272-273)

— Current State of the VA Research Effort at the Western Blind Rehabilitation Center: Loyal E. Apple 10-22(458-462)

— Mobility and Reading Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports: L.E. Apple, R. Bennett, W. Ekstrom, and D.C. Cooper 10-21(163-165)

— Open House Celebrates the Opening of the New Western Blind Rehabilitation Center. Notes and News 10-30(280-281)

— A Preliminary Followup Study of Electronic Travel Aid Users: Nancy Darling, Gregory L. Goodrich, and J. Kenneth Wiley 10-27(82-91)

VA Hospital, Palo Alto, California

— Seating Systems for Body Support and Prevention of Tissue Trauma. Contractor Reports: I. Perkash 10-29(162) Wallace Motloch (Stanford University, Palo Alto, Calif.) 10-30(258-268)

— Second Rehabilitative Engineering Research and Development Center Established at VA Hospital, Palo Alto, California. Notes and News 10-30(283)

VA Hospital, Pittsburgh, Pennsylvania

— Compression Amplification and Speech Intelligibility in Noise. Contractor Reports: J.J. Sung 10-27(199) 10-28(240-241) 10-29(185, A final report)

VA Hospital, Richmond, Virginia

— Immediate Postoperative Application of Upper-Extremity Orthoses. Contractor Reports: Charles L. McDowell 10-21(137-138)

VA Hospital, San Francisco, California

— Below-Knee Amputation with Immediate Postoperative Fitting of

Prosthesis. Contractor Reports: W.S. Moore, A.D. Hall, and L.A. Wilson 10-21(128) 10-23(300) 10-24(225) 10-25(200) 10-26(307) 10-28(156 no report) Program transferred to VA Hospital, Tucson, Arizona

VA Hospital, Seattle, Washington

— VAH Seattle Amputee Service. Contractor Reports: Ernest M. Burgess (Prosthetics Research Study, Seattle, Washington) 10-21(126 no report) 10-23(290 no report) 10-24(222-225) 10-25(198-200) 10-26(305) 10-27(137) 10-28(156) 10-29(123-124) 10-30(197-198)

VA Hospital, Syracuse, New York

— Evaluation of Electrical Techniques for Stimulation of Hard Tissue Growth. Contractor Reports: R.O. Becker, J.A. Spadaro, and A.A. Marino 10-27(180-184) 10-28(224 no report) 10-29(133-135) 10-30(206-209)

VA Hospital, Tucson, Arizona

— Below-Knee Amputation with Immediate Post-operative Fitting of Prosthesis. Contractor Reports: W.S. Moore 10-29(124-125) 10-30(199) For earlier reports of this program *see* VA Hospital, San Francisco, California

VA Hospital, Washington, D.C.

— Development of a Hearing Aid System with Independently Adjustable Subranges of its Spectrum using Microprocessor Hardware. Contractor Reports: D. Graupe (Colorado State University, Fort Collins, Colorado) G.D. Causey (University of Maryland, College Park Maryland) 10-29(178-179) 10-30(275-276)

— *See also* Colorado State University, Fort Collins, Colorado, and University of Maryland, College Park, Maryland

— The Development of Improved Techniques for the Analysis of Hearing Aid Performance. Contractor Reports: G.D. Causey, J. Punch, H.C. Schweitzer, E. Elkins, and L. Beck 10-27(191-196) 10-28(235-238) 10-29(179-184) 10-30(276-278)

— *see also* University of Maryland, College Park, Maryland

VA Hospital, West Haven, Connecticut. Eastern Blind Rehabilitation Center

— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: G. Gillispie, William De l'Aune, Patricia D. Gadbaw, Chester Lewis 10-21(170-173) 10-23(348-351) 10-24(271-274) 10-25(238-241) Donald E. Garner 10-26(360-363) 10-27(196-198) 10-28(238-240) 10-29(164-166) 10-30(261-268)

— Research at the Eastern Blind Rehabilitation Center: George M. Gillispie and William De l'Aune 10-22(463-468)

VA Hospital, West Roxbury, Massachusetts

— Development of a Wheelchair Using a Myoelectric Control Sys-

tem. Contractor Reports: A.B. Rossier, M. Sarkarati, and G.E. Crawford, Jr. 10-29(158-159) 10-30(255-258)
— West Roxbury's New SCI Center is Open. Notes and News 10-30(281)
VA Hospital, Wilmington, Delaware
— Maxillofacial Restorative Materials and Techniques, Contractor Reports: J.F. Lontz, and J.W. Schweiger (Temple University School of Dentistry, Philadelphia, Pennsylvania) 10-30(223-248)
— *See also* Temple University, School of Dentistry, Philadelphia, Pennsylvania
Valenti, Mario C.
— Mechanical Prosthesis of the Knee. Recent Patents 10-29(195)
Valutec, Ltd., Value Engineering, Zurich, Switzerland
— Manufacturer, LEVO Stand-Up Wheelchair, VAPC Research Report 10-30(127-128)
Vanderheiden, Greg C.
— Auto-Monitoring Communication Devices for Handicapped Persons. Recent Patents 10-24(284)
Van Modifiers Recognized by VAPC, Listed. VAPC Research Report 10-25(169-170)
Vans
— Mobility Aids for the Severely Handicapped—A Status Report: Charles M. Scott and Ronald E. Prior 10-26(192-213)
— Special Vans Driven by Paralyzed Vets from N.Y. to Washington, D.C. Notes and News 10-22(522-524)
— Van Wheelchair Lift Manufacturers and Van Modifiers Recognized by VAPC, VAPC Research Report 10-25(169-170)
— *See also* Automotive Driving Aids; Development and Evaluation of Advanced Automotive Adaptive Systems (Contractor Report); Mobility Aids for the Severely Handicapped (Contractor Report)
VA/NU Myoelectric Hand
— Clinical Application Study of Externally Powered Upper-Limb Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
— Supplemental Sensory Feedback for the VA/NU Myoelectric Hand. Background and Preliminary Designs: Ronald E. Prior, John Lyman, Philip A. Case and Charles M. Scott 10-26(170-191)
Van Wheelchair Lift Manufacturers and Van Modifiers, VAPC Research Report 10-25(169-170)
VAPC
— Clinical and Physiological Evaluation of Seat Cushions for the Paralyzed. Contractor Reports: Bok Y. Lee (VA Hospital, Castle Point, New York) and Leon Bennett (VAPC) 10-29(160-161) 10-30(258)

— Stump Stress Analysis. Contractor Reports: L. Bennett 10-29(163)
VAPC Above-Knee Endoskeletal Prosthesis (Multiplex System) Clinical Study Terminated, Results, VAPC Research Report, 10-21(72-73)
— Graphite-Epoxy Shank to be Developed, VAPC Research Report 10-21(72)
VAPC Above-Knee Endoskeletal Structures, VAPC Research Report 10-21(72-73)
VAPC Battery Tester, VAPC Research Report 10-23(228)
VAPC Breath-Operated Microfiche Reader, VAPC Research Report 10-23(250)
VAPC Communicator, VAPC Research Report 10-23(249-250)
VAPC Contractual Development Program, VAPC Research Report 10-24(206-208)
VAPC Electric Elbow, VAPC Research Report 10-23(223-224)
VAPC Electric Hook, VAPC Research Report 10-23(224-225)
VAPC Electro-Hydraulic Servo Control for Handicapped Drivers, VAPC Research Report 10-24(196-198)
VAPC Functional Equino-Varus Ankle-Foot Orthosis, VAPC Research Report 10-24(160-162)
VAPC Home Environmental Control System, VAPC Research Report 10-21(83-85) 10-23(243-245)
VAPC Hospital Environmental Control, VAPC Research Report 10-21(81-83) 10-26(222)
VAPC Indoor-Outdoor Wheelchair, VAPC Research Report 10-23(235-236) 10-24(176-177)
VAPC Microfiche Reader, VAPC Research Report 10-25(143-144)
VAPC Pneumatic Wheelchair Control Model II, VAPC Research Report 10-27(106)
VAPC Powered Ambulator, VAPC Research Report 10-28(113-114)
VAPC Powered Wrist-Hand Orthosis, VAPC Research Report 10-24(162)
VAPC Projection Screen Reading Machine, VAPC Research Report 10-24(175-176)
VAPC Remote Alarm, VAPC Research Report 10-28(100)
VAPC Remote Station Environmental Control, VAPC Research Report 10-24(162-166)
VAPC Special Clinic Team, VAPC Research Report 10-24(205-206)
VAPC Wheelchair Battery Tester, VAPC Research Report 10-25(148-150)
VAPC Wireless Environmental Control, VAPC Research Report 10-21(85-86) 10-23(245-246)
VA Prosthetics Center, New York, New York
— Needs of the Veterans Administration: Current State of the Art:

Anthony Staros 10-22(13-14)
— VA Prosthetics Center Program for Electric Wheelchairs and Other Non-licensed Mobility Aids: Ronald Lipskin 10-22(326-336)
VA Prosthetics Center Research, Development, and Evaluation Program: Edward Peizer 10-22(469-477)
— Lower-Limb Prosthetics 10-22(469-471)
— Composite Endoskeletal Structures 10-22(470)
— Graphite Fiber Composite Keel for SACH Feet 10-22(470-471)
— Machine Forming Plastic Sockets 10-22(471)
— UC-BL Four-Bar Linkage Polycentric Knee 10-22(470)
— UC-BL Shank Torque Absorber 10-22(470)
— VAPC Above-Knee Endoskeletal Structures 10-22(469)
— Weber-Watkins Rotator for Lower-Limb Prostheses 10-22(470)
— Orthotics 10-22(471-472)
— Externally Powered Orthoses 10-22(472)
— Liberson Functional Electrical Stimulation 10-22(471)
— Ortho-Walk Orthosis 10-22(471)
— Polypropylene Knee Orthosis with Supra-Patellar Suspension Strap 10-22(472)
— Remote Manipulator 10-22(472)
— Spinal-Cord-Injured Patient 10-22(473-477)
— Environmental Control Systems 10-22(474-476)
— Mobility Aids 10-22(474)
— Patient Handling Devices 10-22(476-477)
— Upper-Limb Prosthetics 10-22(472-473)
— Johns Hopkins Applied Physics Laboratory Prosthesis 10-22(473)
— VAPC Free-Swing Electric Elbow 10-22(472-473)
— VAPC Hand 10-22(473)
— VAPC Hook 10-22(473)
VA Prosthetics Center Research Reports: Anthony Staros and Edward Peizer 10-21(69-108) 10-23(218-264) 10-24(156-208) 10-25(134-177) 10-26(214-271) 10-27(92-120) 10-28(91-131) 10-29(79-99) 10-30(119-175)
— Development and Evaluation
— Orthotics — Lower Limb
— Adjustable Knee-Ankle-Foot and Ankle-Foot Orthosis, (KAFO and AFO 10-23(225-226)
— Orthotic Transverse Rotator 10-28(96) 10-29(81-82)
— Plastic Knee Orthosis 10-29(81)
— Polypropylene Knee Orthosis 10-25(138)
— Polypropylene Knee Orthosis with Suprapatellar Strap Suspension 10-23(225)
— Vacuum-Formed Ankle Foot Orthoses 10-21(77-78)

— Vacuum-Formed Orthoses 10-23(225)
— VAPC Functional Equino-Varus Ankle-Foot Orthosis 10-24(160-162)
— Orthotics — Upper Limb
— Counter-Force Elbow Orthosis 10-28(96)
— Electric Opponens-Type Hand Splint 10-23(226-228)
— Functional Elbow Orthosis 10-25(138-140) 10-26(218-220)
— Hosmer Electrically Powered Orthoses 10-21(79)
— Orthosis for Brachial Plexus Injury 10-21(80-81)
— VAPC Powered Wrist-Hand Orthosis 10-24(162)
— Viennatone Orthomot Myoelectric Orthosis 10-21(79-80)
— *see also* Spinal Cord Injury Rehabilitation — Orthotics
— Prosthetics — Lower Limb
— Above-Knee Endoskeletal Structures 10-26(217-218)
— Composite Endoskeletal Structures 10-21(70-72)
— DAW Stump Sock System 10-27(94)
— Electromyographic Knee Control System 10-24(157-160
— Graphite-Epoxy Composite Components 10-27(93-94)
— Graphite-Epoxy Composite Shank for Partial Thigh Endoskeletal Prostheses 10-23(220-221) 10-25(136) 10-26(216) 10-28(93)
— Graphite-Epoxy Knee Joint for Below-Knee Prosthesis 10-26(216) 10-29(80)
— Graphite-Epoxy SACH Foot Keels 10-26(216-217)
— Moore Load Cell for Lower-Limb Component Testing 10-23(222-223)
— Mortensen Safety Knee 10-28(93-94)
— Nitschke-Tindall Ankle Rotator 10-28(94-95)
— Nylon Knee Joint 10-29(80)
— Pilot Study of New Artificial Limb Contract 10-23(222)
— Plastic Knee Joint for Below-Knee Prosthesis 10-29(80)
— Polypropylene Hip Joint and Pelvic Band 10-25(136-137) 10-26(217) 10-27(94)
— Prosthetic Skin 10-26(217) 10-28(93) 10-30(120)
— PRS Load Cell 10-30(120)
— UC-BL Four-Bar Polycentric Knee 10-27(94-95)
— UC-BL Pneumatic Swing Control Unit 10-23(222)
— UC-BL Torque Absorber 10-23(219-220)
— U.S. Manufacturing Co. Four-Bar Linkage Knee 10-29(80)
— Vacuum Forming Plastic Sockets 10-21(72)
— VAPC Above-Knee Endoskeletal Structures 10-21(72-73)
— Weber-Watkins Rotator for Lower-Limb Prostheses 10-21(74)
— Prosthetics — Upper Limb
— APL (Applied Physics Laboratory, Johns Hopkins University) Electric Prosthesis 10-21(74-77)

— Improved Suspension for Wrist Disarticulation 10-28(95)
— The NU Synergetic Hook 10-28(95-96)
— Salt-Water-Resistant Below-Elbow Prostheses 10-25(137)
— VAPC Electric Elbow 10-23(223-224)
— VAPC Myoelectric Hook 10-23(224-225)
— Spinal-Cord-Injury-Rehabilitation — Automotive Systems and Driving Aids
— Adaptive Automotive Equipment Manufacturers in Compliance with VA Document VAPC-A-7505-8 10-25(168)
— Automotive and Driving Aids 10-23(251-253)
— Design Changes in Mechanical Adaptive Automotive Hand Control Systems 10-24(198)
— Development of Standards for Van Wheelchair Lifts 10-25(169)
— Driving Seats for Vans 10-23(257-258)
— E-Z Tilt-a-Board Loader 10-28(122-123)
— E-Z-1 Wheelchair Carrier 10-28(123-124)
— Handicar TVE (Teilhol Voiture Electrique) 10-30(143-144)
— Mann's E-Z Way Chair Lift 10-28(124-125)
— Pak-A-Rak 10-30(144-145)
— Power Car Door 10-26(257) 10-27(116)
— Servo-Type Driving Controls for the Handicapped 10-23(253-254)
— Tie-Down for Wheelchair-Riding Van Passengers 10-23(255-257)
— Tri-Pan Quad Steering Device No. 3522 10-26(259)
— VA Standards Design and Test Criteria for Safety and Quality of Automatic Wheelchair Lift System for Passenger Motor Vehicles 10-30(148-173)
— VA Standard Design for Safety and Quality of Automotive Adaptive Equipment VAPC-A-7505-8 10-25(162-167)
— Van Wheelchair Lift Manufacturers and Van Modifiers 10-25(169-170)
— VAPC Electro-Hydraulic Servo Control for Handicapped Drivers 10-24(196-198)
— Volvo Driving System 10-27(116)
— Volvo Servo-Control System 10-26(258)
— Spinal-Cord-Injury Rehabilation—Beds, Lifts, Transfer Aids, etc.
— Ambulift 10-26(255-256) 10-30(137)
— AMBRDL Microsphere Mattress 10-24(194-196)
— Autolift 10-26(253-255) 10-30(137-139)
— Blair Bed 10-24(190)
— ConVaid Mobile Prone Stander 4000 10-25(156-158)
— Crozier Transfer System 10-24(188-190)
— Duphar Life Lift 10-27(114) 10-30(133)

— Gaymar High Density Fluid (HDF) Support System 10-21(103-104)
— Godfrey Standing Aid 10-24(187-188)
— IMSECO Orthopedic Seating System 10-24(191-192)
— IMSECO Patient Transfer System 10-24(193-194)
— Jouk Power-Aid Ambulator 10-24(185-187)
— LaCaron Lift Chair Model 76 10-27(115) 10-28(120)
— Mecalift 10-26(256-257) 10-30(139-142)
— Mercy Lift 10-21(101-103)
— Mobilizer 10-21(100-101) 10-27(111-113)
— Reyer Lift 10-25(153)
— Royalaire Air-Fluidized Bed 10-21(104-106)
— Sanyo Hydraulic Walker 10-25(153-154)
— Speedo Aqualift Swimsuit 10-25(154-156)
— Therapeutic Wheelchair Rocker 10-25(158-159)
— The Wayne Chair 10-25(159-161)
— Spinal-Cord-Injury Rehabilitation — Body Support Systems
— Action No. 6000 Bed Pad 10-26(251-253)
— Blair Bed 10-28(115-116)
— Castor Portable Standing Frame 10-27(111) 10-30(133)
— Edco-Matic Chair 10-26(257)
— E-Z Patient Turning System 10-28(118-119) 10-29(95-98)
— Gaymar High Density Fluidized (HDF) Bed 10-26(257)
— Godfrey Standing Aid 10-26(246-247)
— Hess Rotary Bed 10-26(250-251)
— MEDPRO Chair Flotation Cushion 10-28(117)
— RoHo Balloon Cushion 10-28(117-118)
— Royalaire Bed 10-26(253)
— Sevier Mobile Bed 10-26(248-250)
— Stand-Aid 10-30(133)
— Steeper "Co Ro" Bed 10-26(247-248)
— Wheelchair Cushion Study 10-28(116-117)
— Wheelchair Pad Movement Monitor 10-28(119-120)
— Spinal-Cord-Injury Rehabilitation — Communication Aids
— Breath-Controlled Microfilm Reader 10-21(92)
— Ealing Reader *see* Saltus Reading System
— Lifeline System 10-27(101-102)
— Manual Communications Module 10-27(98)
— Mechanically Operated Voice Synthesizer 10-27(100-101)
— Microfiche Reader 10-21(91-92) 10-25(143-144) 10-30(125)
— Microfilm Reader 10-26(224-225)
— Microlert System 10-27(105)
— New Ealing Reader 10-27(102-104)
— Portable Telephone 10-27(98-100)
(1) Kari-Fone 10-27(99-100)

(2) PortaCall 10-27(100)
— Portaprinter 10-25(144-145)
— Prentke Romich Intercom System 10-28(100)
— Saltus Reading System 10-29(83-85) 10-30(123-124)
— Sip "N" Puff Dialer 10-27(104-105)
— Tufts Interactive Communicator 10-23(248-249)
— VAPC Breath-Operated Microfiche Reader 10-23(250)
— VAPC Communicator 10-23(249-250)
— VAPC Remote Alarm 10-28(100)
— VOTRAX Handi-Voice System 10-28(101-102)
— Zero-Pressure Telephone Dialer 10-27(104)
— ZYGO Model 16 Communication Board 10-28(101)
— Spinal-Cord-Injury Rehabilitation — Environmental Control Systems
— Adapted VAPC Hospital Environmental Control System for Home Use 10-28(100)
— AMBRDL Random Access Environmental Control 10-25(140-142)
— Bunting Remote Operated Television 10-24(173-174)
— Comfortcom 10-23(241-242)
— Fidelity Comfort and Communication Control System 10-26(220) 10-27(97)
— Fidelity Comfort and Communication System Security Sentinel 10-26(222-223) 10-27(97-98) 10-30(122-123)
— GENIE Environmental Control 10-24(166-168)
— Heimco Nurse Call 10-24(173)
— Johns Hopkins Remote-Manipulator 10-28(98)
— Northwestern University Comfort and Communications System (NUCCS) 10-23(242-243)
— Nu-Life Environmental Control System 10-24(168-171)
— Paratrol MK II 10-25(142)
— POSSUM Environmental Control 10-24(171-172)
— Prentke Romich ECU 1 10-27(95) 10-28(99)
— Remote Control AM/FM Radio 10-30(121-122)
— Remote Outlet 10-28(99)
— Remote Station Environmental Controls 10-21(86)
— ROBOT System 10-26(220)
— Stanley Silent Swing Door Operator 10-29(82-83)
— Telescopic Mouth Instrument 10-21(93-94)
— Touch-Operated Selector Control 10-26(220-222) 10-27(96-97)
— VAPC Home Environmental Control System 10-21(83-85) 10-23(243-245)
— VAPC Hospital Environmental Control 10-21(81-83) 10-26(222)

— VAPC Projection Screen Reading Machine 10-24(175-176)
— VAPC Remote Station Environmental Control 10-24(162-166)
— VAPC Wireless Environmental Control 10-21(85-86) 10-23(245-246)
— The VIP-100 Speech Recognition Environmental Control System 10-28(96-98)
— Voice-Operated Environmental Controls 10-21(92-93)
— Voice-Operated Typewriter and Environmental Control System 10-27(95)
— Voice Recognition Systems 10-23(246-248) 10-24(172-173)
— Zero-Pressure Remote Power Control 10-26(223)
— Spinal-Cord-Injury Rehabilitation — Miscellaneous
— Adult Powered Tricycle 10-28(113)
— APOR Safety Shower and Tub Guard 10-30(145-146)
— Bailey III Cushion Grip Tape 10-28(125-126)
— E-Z Reacher #201 10-23(250-251)
— Gyro-Gym Therapeutic Exerciser 10-26(262-263)
— Handi-Cup 10-30(147)
— Porta-Care Sink 10-30(145-146)
— Portable Inflatable Bathtub 10-30(146-147)
— Syndor Feeder 10-26(261-262)
— Winsford Feeder 10-28(126-127)
— Spinal-Cord-Injury Rehabilitation — Mobility Aids
— Adult Powered Tricycle 10-28(113)
— Arrow Wheelchair 10-29(90-93)
— Ausmus Moto-Stand 10-28(114)
— Edco-Hemi Walker 10-26(244)
— Electric Back-Recliner Kit 10-29(86-87)
— Electronic Power Conversion Kit for Wheelchairs 10-29(85-86)
— Freewheeler Power Wheelchair 10-29(85)
— Guardian Folding Walker 10-26(242-244)
— Icarus Easy Transfer Wheelchair Attachment 10-29(87-90)
— Independence Powered Recliner Kit 10-30(131-133)
— Jouk Standing Ambulator 10-26(241)
— LEM Power Chair 10-28(114-115) 10-30(126-127)
— LEVO Stand-Up Wheelchair 10-30(127-130)
— Motorized Litters 10-21(90-91)
— Postura Adjustable Modular Support System 10-26(244-246)
— Pyramid Folding Quad Cane 10-28(105-106)
— Rigal Walker Tray 10-27(105-106) 10-29(94-95)
— Special Mobility Aid for Veteran with Hemipelvectomy 10-26(239-241)

— VAPC Powered Ambulator 10-28(113-114)
— Wheelchair Shock Absorber 10-30(130)
— *see also* Wheelchairs and Accessories (below)
— Spinal-Cord-Injury Rehabilitation — Orthotics
— Exer-Shoe 10-21(107)
— Isotorque Ankle Dorsiflexor 10-21(106-107)
— Liberson Electrical Stimulation System 10-27(115-116)
— L'Nard Sani-Comfo Arm Splint 10-30(143)
— Multi-Podus Therapeutic Foot and Leg Unit 10-26(259-261)
— Sani-Comfo Arm Splint 10-27(115)
— Spinal-Cord-Injury — Wheelchairs and Accessories
— A-BEC Electric Wheelchair 10-24(180-182) 10-25(145-147)
— The Advanced Wheelchair 10-21(97-98)
— Amigo Motorized Wheelchair 10-27(107-108)
— Automatic Transmission for Powered Wheelchairs 10-26(226-227)
— Burris Spinal Cord Injury Recliner 10-23(238-239)
— BykFil Rubber Tire Compound 10-25(150-151)
— Chin Control Powered Swing Away 10-28(103-105)
— Davis Suspension System 10-26(242)
— Electric Back-Recliner Kit 10-28(103)
— Electrically Operated Brake for Powered Wheelchairs 10-27(106-107)
— Electronic Power Conversion Kit for Wheelchairs 10-26(246) 10-28(102)
— Everest and Jennings Hub-Brake Wheel-Lock System 10-27(110-111)
— Everest and Jennings Rehabilitation Shower/Commode Wheelchair 10-27(111)
— Everest and Jennings "32" Power Drive 10-24(177-180)
— Freewheeler Electric Wheelchair 10-26(228-229)
— Foot Control for Electrically Powered Wheelchairs 10-21(88-89)
— Gasoline-Fueled Mobility Aids 10-23(230-235)
— GenTel Motor-in-the-Hub Powered Wheelchair 10-28(109)
— The Hayes Pneumatic Control for Wheelchairs 10-21(97)
— Icarus Easy Transfer Wheelchair Attachment 10-27(107)
— Illuminated Reachers for Wheelchairs 10-28(114)
— Independence Wheelchair 10-23(237-238)
— Indoor-Outdoor Wheelchair 10-23(235-236) 10-26(232-234)
— Insta Gaiter 10-28(110-111)
— Invacare Elite Series 800 Wheelchair 10-27(108-110)
— Lakematic Powered Wheelchair, 76 Series 10-23(239-240)
— Montreal Head Control 10-24(182-183)

— Motorette 24 Volt Power Package for Wheelchairs 10-21(99)
— National Wheelchair 10-28(109-110)
— Naval Electronics Laboratory Center Head Control 10-24(184-185)
— Naval Electronics Laboratory Center (San Diego, California) Stander 10-23(241)
— Naval Electronics Laboratory Center Stand-Up Wheelchair 10-24(185) 10-25(151-153)
— Newton Ultra Lightweight Wheelchair 10-23(240)
— Plantar and Dorsiflexion Foot Plates for Wheelchairs 10-28(114)
— Powered Wheel 10-25(147-148)
— Powered Wheelchairs 10-21(94-97)
— PRAHN Wheelchair 10-26(234-236)
— Printed Motors for Powered Wheelchairs 10-26(229-232)
— Stainless Medical Products Electric Wheelchairs 10-26(225-227) 10-28(112-113)
— Sun Industries Curb-Climbing Electric Wheelchair 10-28(106-109)
— Super Voyager II 10-23(230)
— Theradyne Electromatic Wheelchair 10-21(106)
— Theradyne Marquis Wheelchair 10-21(106)
— Tri-Wheeler 10-25(151)
— Twenty-Four Volt Everest & Jennings Electric Wheelchair 10-21(98-99)
— VAPC Battery Tester 10-23(228)
— VAPC Indoor-Outdoor Wheelchair 10-24(176-177)
— VAPC Pneumatic Wheelchair Control, Model II 10-27(106)
— VAPC Wheelchair Battery Tester 10-25(148-150)
— Wheelchair Powered with Printed Circuit Motors 10-23(228-229)
— Technological Utilization Program
— Evaluation of Aids for the Elderly 10-24(203-204)
— Methods 10-23(263-264)
— Operations 10-23(264)
— Purpose 10-23(263)
— Testing (Compliance)
— Adaptive Automotive Hand Controls 10-23(260-262) 10-24(201-202) 10-27(118-119)
— APRL Voluntary Closing Hook 10-27(117) 10-30(174)
— Contracted Services 10-24(200)
— Flammability and Toxic Fume Tests 10-24(200)
— Hosmer External Elbow Assembly 10-28(128-129)
— Internal Elbow Assembly 10-27(117) 10-30(174)

— ISPO Collaborative Program 10-24(199-200)
— LAPOC Safety Knee 10-28(129)
— Lower-Limb Torque Absorbers 10-24(198-199) 10-25(171) 10-26(264)
— Lumbosacral Corset Material 10-23(260) 10-24(201)
— Mauch Knee Bolt 10-24(199)
— Multiplex Mark II Above-Knee Prosthesis 10-28(129-130)
— Positive-Locking Knee/Shank Assemblies 10-27(117)
— SACH Feet 10-23(258) 10-25(171) 10-27(117)
— Shrink Resistant Woolen Stump Socks 10-25(172)
— Sierra/APRL #44 Voluntary Closing Hand 10-21(108)
— Sierra/APRL Voluntary Closing Hook 10-21(108)
— Sierra Voluntary Closing Hand (Hosmer-Dorrance) 10-28(129)
— Standards (Lower-Limb Prosthetic Assemblies and Components, draft) 10-27(117) 10-28(127-128)
— Stump Sock Materials 10-23(260)
— Stump Socks 10-23(259-260) 10-25(172) 10-26(264) 10-30(174)
— Test Standard for Wheelchair Cushions 10-26(263-264)
— Test Standards for Wheelchair Cushions 10-24(200) 10-25(171)
— Upper-Limb Components 10-23(260) 10-24(201) 10-25(171) 10-26(264)
— Wheelchairs 10-25(172) 10-26(264) 10-30(174)
— Woolen and Cotton Stump Socks 10-25(172)
— VAPC Clinic Team 10-24(205-206) 10-25(173-177) 10-26(264-271) 10-27(119-120) 10-28(130-131) 10-29(98-99) 10-30(174-175)
— Case Histories 10-25(174-177) 10-26(267-271)
— Development 10-24(206)
— Evaluation 10-24(206)
— Patient Profiles 10-25(173-174) 10-26(264-267)
— Statistics of Veterans Treated by the Clinic Team;
— July 1 to December 31, 1975 10-25(174)
— January 1 to June 30, 1976 10-26(265-266)
— July 1 to December 31, 1976 10-27(119-120)
— January 1 to June 30, 1977 10-28(130-131)
— July 1 to December 31, 1977 10-29(99)
— January 1 to June 30, 1978 10-30(175)
— Service 10-24(205)
— Teaching 10-24(205-206)
— VAPC Contractual Development Program 10-24(206-208)
VA Prosthetics Research Program
— A Basic Theme of Cooperation: Eugene F. Murphy 10-22(1-4)
VA-Rancho Gait Analyzer

— Contractor Reports: Jacquelin Perry. The Professional Staff Association of the Rancho Los Amigos Hospital, Downey, California 10-26(331-333)
— *See also* under title "Clinical Gait Analyzer" 10-23(329 no report) 10-24(251-253) 10-25(214)
VA Rehabilitative Engineering Research and Development Service, Department of Medicine and Surgery *see* Veterans Administration
VA Research Center for Prosthetics *see* Office of Technology Transfer; formerly Research Center for Prosthetics
Variable-Height-Powered Wheelchair for the Quadriplegic Driver: Don M. Cunningham 10-22(337-369)
— Discussion 10-22(363-365)
— Geometric and Functional Description of Mark IV (1974) UC Powered Variable-Height Wheelchair (PRAHN) 10-22(349-363)
— History 10-22(338-347)
— Curb- and Stair-Climbing Devices 10-22(346)
— Powered Wheelchairs 10-22(343-345)
— Supporting Surface 10-22(345)
— Variable-Seat-Height Wheelchairs 10-22(345-346)
— Wheelchair Transfer 10-22(347)
— Philosophy 10-22(367-368)
— Proposed Future Work (1975) 10-22(366-367)
— The University of California Variable-Height Wheelchair 10-22(347-349)
— Design Constraints for the UC Daily Activities PRAHN Wheelchair 10-22(347-349)
Varispeech Machine *see* Reading Machines
VA Standard Design and Test Criteria for Safety and Quality of Automatic Wheelchair Lift Systems for Passenger Motor Vehicles
— VAPC Research Report (Compliance Testing) 10-30(148-173)
— *See also* Standards
VA/UCLA Arm Prostheses *see* Upper Limb Prosthetics
Vehicle Invalid Lift Device
— Recent Patents: Otto C. Holecek 10-29(196)
Verhonick, Phyllis J.
— Edge Light: A New Approach to Studying the Microvascularization of the Skin: J.F. Kissinger, P.J. Verhonick, and D.W. Lewis 10-29(65-78)
— Thermographical Investigation of Decubitus Ulcers: R.S. Trandel, D.W. Lewis, and P.J. Verhonick 10-24(137-155)
A Versatile Joint Rotation Device for Externally Energized Upper-Limb Prostheses: Paul Meadows and John Lyman 10-24(38-42)
— Introduction and Overview 10-24(38-40)
— Physical Description of the Rotator 10-24(40-42)
Veterans Administration Prosthetics Center, 252 Seventh Avenue, New York, N.Y. 10001

AD-A070 587 VETERANS ADMINISTRATION WASHINGTON DC DEPT OF MEDICI--ETC F/G 5/2
BULLETIN OF PROSTHETICS RESEARCH. SPRING 1979,(U)
1979 E F MURPHY
UNCLASSIFIED BPR-10-31 NL

6 OF 6
AD
A070587



END
DATE
FILMED
8-79
DDC

— Control and Communication Devices for the Severely Disabled: Ronald Arroyo 10-25(55-68)
— An Occipito-Zygomatic Cervical Orthosis Designed for Emergency Use—A Preliminary Report: Gustav Rubin, Malcolm Dixon, and Joel Bernkopf 10-29(50-64)
— Testing of Electrical Transcutaneous Stimulators for Suppressing Pain: Carl P. Mason 10-25(38-54)
— *See also* VAPC
Veterans Administration Rehabilitative Engineering Research and Development Service, Department of Medicine and Surgery
— Vernon L. Nickel Appointed Director of VA Rehabilitative Engineering R & D Service. Notes and News 10-28(243)
— Rehabilitative Engineering—A New Era—Editorial. Vernon L. Nickel 10-30(1-7)
— Technology Transfer—Editorial. Eugene F. Murphy 10-29(1-7)
— Veterans Administration Rehabilitative Engineering Reference Collection, Notes and News 10-29(187-188)
Vestibular-Optical Reflexes
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Two Modes of Processing Visual Information 10-26(51-58)
— Relationship to Vestibular-Optical Reflexes 10-26(56)
Viennatone Orthomot Myoelectric Orthosis, VAPC Research Report 10-21(79-80)
The VIP-100 Speech Recognition Environmental Control System, VAPC Research Report 10-28(96-98)
Virginia Commonwealth University
— Medical College of Virginia, Richmond, Virginia, *see* Jeanette F. Kissinger
Vision
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
Visotactor
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— A Tactile Aid Evaluated 10-26(146)
Visotoner
— Research and Evaluation of Audible Output Print Reading Aids for the Blind. A Final Report: Michael Carbery and Margaret Butow 10-26(139-169)
— Visotoner Development 10-26(140-146)
Visual Function
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Evaluation of Visual Function 10-26(50-59)

Visual Information
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Two Modes of Processing Visual Information 10-26(51-58)
Visual vs. Perceptual Problems
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Visual Training Without Aids 10-26(60-74)
Visual Prostheses
— Electrocortical Prostheses: Leicester W. Farmer 10-30(108-109)
Visual Training
— Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— Perceptual Learning and Visual Training 10-26(57-58)
— Visual Training without Aids 10-26(60-74)
Vocal Interface Division, Federal Screw Works, Troy, Michigan *see* Federal Screw Works, VAPC Research Report
Vocational and Educational Opportunities Described in Booklet for the Disabled (Human Resources Center)
— Notes and News 10-27(202-203)
Voice-Controlled System
— Engineering Students Test Voice-Controlled System for Quadriplegics. Notes and News 10-25(247)
Voice-Controlled Wheelchair with Manipulator is Product of VA-NASA-HEW Cooperation
— Notes and News 10-26(367)
Voice-Operated Environmental Controls, VAPC Research Report 10-21(92-93)
Voice-Operated Typewriter and Environmental Control System (VOTECS), VAPC Research Report 10-27(95-96)
Voice Recognition Systems
— Dialog Systems, Inc., Cambridge, Mass., VAPC Research Report 10-23(248)
— Discussed: VAPC Research Report 10-23(246-248)
— Robert Roemer, Univ. of California at Santa Barbara, Calif. Voice Recognition System, VAPC Research Report 10-24(172-173)
— Threshold Technology, Cinnaminson, New Jersey, VAPC Research Report 10-23(248)
— Voice Recognition Systems, VAPC Research Report 10-23(246-248)
— VOTECS (Voice Operated Typewriter and Environmental Control System), VAPC Research Report 10-23(246-248)
Voiding
— Electrode Implantation in the Human Body: Margaret I. Babb

and Anthony M. Dymond 10-23(51-150)
— Electrical Stimulation for Bladder Control 10-23(92-96)
Volk, Andrew M.
— Auto-Monitoring Communication Devices for Handicapped Persons. Recent Patents 10-24(284)
A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W.R. Dyck, S. Onyshko, D.A. Hobson, D.A. Winter, and A.O. Quanbury 10-23(169-186)
— Abstract 10-23(169-170)
— Amputee Testing 10-23(182-185)
— Bench Testing of Hydraulic System 10-23(173-178)
— Conclusion 10-23(185-186)
— Design of EMG Control Electronics 10-23(178-181)
— Design of Hydraulic System 10-23(171-173)
Volvo of America Corp., Rockleigh, New Jersey
— Volvo Servo-Control System, VAPC Research Report 10-26(258)
Volvo Driving System, VAPC Research Report 10-27(116)
VOTECS
— Voice-Operated Typewriter and Environmental Control System, VAPC Research Report 10-23(246-248)
VOTRAX Handi-Voice System, VAPC Research Report 10-28(101-102)
Votrax Speech Synthesizer
— Use Planned with Microcomputer in Mauch Laboratories High Performance Cognodictor Reading Machine for the Blind 10-27(61)

W

Wagner Orthopedic Supply Co.
— SACH Feet Compliance Testing, VAPC Research Report 10-23(258)
Walkamatic Reciprocal Motion Walker
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Walkers 10-30(70-75)
Walker-Cane Combination
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Walkers 10-30(70-74)
Walkers
— Edco-Hemi Walker, VAPC Research Report 10-26(244)
— Guardian Folding Walker, VAPC Research Report 10-26(242-244)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)

— Walkers 10-30(70-74)
— Rigal Walker Tray, VAPC Research Report 10-27(105-106) 10-29(94-95)
— Sanyo Hydraulic Walker, Sanyo International, Inc., Tokyo, Japan, VAPC Research Report 10-25(153-154)
— Walkers With Crutch Attachments
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Walkers 10-30(70-74)
Walking Aids for the Blind
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
Walking Aid With Wheels
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Walkers 10-30(70-74)
Wannstedt, Gunilla
— Clinical Evaluation of a Sensory Feedback Device: The Limb Load Monitor: Gunilla Wannstedt and Rebecca L. Craik 10-29(8-49)
Ward, Rex
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, and A. Wood (VA Hospital, Palo Alto, Calif.) 10-23(339-341)
Watson, Paul C.
— Method and Apparatus for Six Degree of Freedom Force Sensing. Recent Patents 10-30(289)
Wayne Chair Co., Warren, Michigan
— Wayne Chair Combination Manually Propelled Wheelchair, Commode Chair, and Shower Chair, VAPC Research Report 10-25(159-162)
Weant, Charles M.
— Stand-up Wheelchair. Recent Patents 10-22(529)
Weber, Albert L.
— Pivot Joint Adapter. Recent Patents 10-25(258)
— Resilient Pivot Joint for an Artificial Leg. Recent Patents 10-24(285)
Weber-Watkins Rotator for Lower-Limb Prostheses, VAPC Research Report 10-21(74)
Weightbearing Signaling and Training Devices
— Clinical Evaluation of a Sensory Feedback Device: The Limb Load Monitor 10-29(8-49)
— Moore Load Cell, VAPC Research Report, 10-23(222-223)
— SCAP 1 (Beeper) and SCAP III, VAPC Research Report 10-23(223)
Weight-Redistribution Orthopedic Appliance
— Recent Patents: Ignatius F. Castiglia 10-30(292)
Weinstein, Allan M.

— Orthopedic Implant Device Retrieval and Analysis. Contractor Reports: A.M. Weinstein (VA Hospital, New Orleans, La.) 10-27(179-180) 10-28(219-224) 10-29(138-139) 10-30(215-216)
Weis, Edmund B. Jr.
— Method and System for Control of a Powered Prosthetic Device. Recent Patents 10-26(376)
Weisgerber, Robert A.
— The Development of Living Skills by the Handicapped (The Stereotoner): R.A. Weisgerber 10-22(436-438)
— Evaluation Procedures for Environmental Sensing, Orientation and Mobility by the Blind. Contractor Reports: R.A. Weisgerber (American Institutes for Research (AIR), Palo Alto, Calif.) 10-25(233, 236-238)
— The Reading of Printed Materials by the Blind. Contractor Reports: R.A. Weisgerber (American Institutes for Research (AIR), Palo Alto, Calif.) 10-21(167-170) 10-23(346-348) 10-24(269-270)
— The Reading of Printed Materials by the Blind (Evaluation of an Ink Print Reading Aid: The Stereotoner). Contractor Reports: R.A. Weisgerber, B.E. Everett, and C.A. Smith (American Institutes for Research (AIR), Palo Alto, Calif.) 10-25(233-236)
Weiss, Marian
— Lectures on Management of the Spinal Cord Injured at New York VA. Notes and News 10-22(521)
Weller, Charles
— Appoints Patricia Horner Administrative Director of Alliance for Engineering in Medicine and Biology. Notes and News 10-26(370)
— Re-Elected President of Alliance for Engineering in Medicine and Biology. Notes and News 10-26(369-370)
West Berlin Technical University
— VAPC Collaborative Test, Series (ISPO Program), VAPC Research Report 10-24(199-200)
Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California
— Open House Celebrates the Opening of the New Western Blind Rehabilitation Center. Notes and News 10-30(280-281)
— A Preliminary Followup Study of Electronic Travel Aid Users: Nancy C. Darling, Gregory L. Goodrich, and J. Kenneth Wiley 10-27(82-91)
— *See also* Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Report: Western Blind Rehabilitation Center.
Western Orthopaedic Association
— Annual Meeting. Calendar of Events 10-23(365) 10-25(265) 10-26(385) 10-27(216) 10-28(265)

Western Pacific Orthopaedic Association
— 5th Congress. Calendar of Events 10-23(366) 10-24(293)
Western Technical Products, Seattle, Washington
— Genie Environmental Control, VAPC Research Report 10-24(166-168)
West Roxbury SCI Center to Apply New Care Concepts
— Notes and News 10-25(251)
West Roxbury's New SCI Center is Open
— Notes and News 10-30(281)
Wheel or Geriatrics Chair Cushion
— Recent Patents: Jody A. Gorran 10-29(196)
Wheel Chair
— Recent Patents: Paul F. Curry 10-23(360)
Wheelchair Accessories and Attachments
— Automatic Bicycle-Type Transmission for Powered Wheelchairs, VAPC Research Report 10-26(238-239)
— Bailey III Cushion Grip Tape (Illust.) VAPC Research Report 10-28(125-127)
— Battery Tester. VAPC Electric Wheelchair Battery Tester 10-25(148-150)
— Cushions *see* Wheelchair Cushions
— Electrically Operated Brake for Powered Wheelchairs 10-27(106-108)
— Electric Back-Recliner Kit (Illust.) 10-28(103-104)
— Electric Power Conversion Kit for Wheelchairs, Solo Products 10-26(246-247)
— E-Z Tilt-a-Board Loader for Wheelchair, VAPC Research Report 10-28(122-123)
— Handi-Cup Beverage Carrier for Wheelchairs, VAPC Research Report 10-30(147)
— Independence Powered Recliner Kits for E&J Fully Reclining Wheelchairs (Illust.) 10-30(131-133)
— Insta Gaiter Electromechanical Power Conversion Kit for Manual Wheelchairs (Illust.) 10-28(110-111)
— Montreal (RIM) Head Control (Illust.) 10-24(182-183)
— Shock Absorber (Illust.), VAPC Research Report 10-30(130)
— Tire Filler *see* BykFil
— Transfer Board for Permanent Attachment (Icarus), VAPC Research Report 10-29(87, Illust. 90-92)
— VAPC Plantar and Dorsiflexion Foot Plates for Wheelchairs, VAPC Research Report 10-28(114)
— Wheelchair Carrier
— EZ-1 Wheelchair Carrier (Illust.) 10-28(123-125)
— Wheelchair-Carrying Mobility Aid

— Chair-E-Yacht Gasoline-Fueled Mobility Aid, VAPC Research Report 10-23(230-232)
— Wheelchair Cushions
— Test Standards for Wheelchair Cushions, VAPC Research Reports 10-25(171)
— *See also* Cushions, Pressure Sore Prevention and Treatment Systems
— Wheelchair Pad Movement Monitor, VAPC Research Report 10-28(119-120)
— Wheelchair Tie-Down for Van, VAPC Research Report 10-23(255-259)
Wheelchair Assembly and Body-Supporting Insert Therefor
— Recent Patents: Lola Alson 10-22(529)
Wheelchair Carrier Corp., Phoenix, Arizona
— EZ-1 Wheelchair Carrier (Illust.) 10-28(123-125)
Wheelchair Controls and Control Systems
— Chin Control Powered Swing Away (Illust.), VAPC Research Report 10-28(103-105)
— Chin Control, VAPC Research Report 10-23(228-231)
— Head Controls
— Montreal (RIM) Head Control (Rehabilitation Institute of Montreal) VAPC Research Report 10-24(182-183)
— Naval Electronics Laboratory Center (San Diego, Calif.) Head Control, VAPC Research Report 10-24(184-185)
— VAPC Pneumatic Control Model II, VAPC Research Report 10-27(106-107)
— Voice-Controlled Wheelchair With Manipulator is Product of VA-NASA-HEW Cooperation. Notes and News 10-26(367)
— *See also* Wheelchair Research
Wheelchair Drive Package
— Recent Patents: Andrew Karchak, Jr. and James R. Allen 10-25(258)
Wheelchair Lifts
— The Improvement of Prosthetic and Orthotic Devices Through Materials Research, Analysis, Design, Clinical Testing, and Team Evaluation. Contractor Reports: M. McDermott, and L.A. Leavitt (Texas A&M University, College Station, Texas) 10-24(235-236)
— Wheelchair Lift Evaluation. Contractor Reports: M. McDermott, Jr., and L.A. Leavitt (Texas A&M University, College Station, Texas) 10-25(205-206) 10-26(318-319) 10-27(149-151)
— *See also* Automotive Driving Aids, Mobility Aids for the Severely Handicapped, VAPC Research Report Listing (SCI)
Wheelchair-Mounted Control Apparatus
— Recent Patents: Alden C. Simmons, James T. McFadden, and

Robert S. Bennett 10-27(210)
Wheelchair Research
— Development of a Wheelchair Using a Myoelectric Control System. Contractor Reports: A.B. Rossier, M. Sarkarati, and G.E. Crawford (VA Hospital, West Roxbury, Massachusetts) 10-29(158-159) 10-30(255-257)
— Indoor/Outdoor Wheelchair Development Described, VAPC Research Report 10-26(232-241)
— Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prostheses and Orthoses. Contractor Reports: W. Seamone and G. Schmeisser, Jr. (The Johns Hopkins University, Silver Spring, Maryland)
— Chin Controlled Electric Wheelchair With Dual Mode Capability 10-30(186-188)
— Clinical Testing (of Chin Controlled Wheelchair) 10-30(188)
— Dual-Purpose Wheelchair Controller 10-29(109-114)
— Powered Assist Wheelchair 10-30(192)
— Mobility Aids for the Physically Disabled. Contractor Reports: C.W. Radcliffe, D.M. Cunningham, J.M. Morris, and L. Lamoreux (University of California, Berkeley, California)
— Fabrication and Preliminary Test of PRAHN Wheelchairs 10-26(294)
— PRAHN (Powered, Reclining, Adjustable-Height and Narrowing) Wheelchairs 10-27(136) 10-28(151) 10-29(122) 10-30(195-196)
— Mobility Aids for the Severely Handicapped. A Status Report: Charles M. Scott and Ronald E. Prior 10-26(192-213)
— *See* "Mobility Aids" entry for detailed listing
— New Head Control for Quadriplegic Patients: Yves Losac'h, Gilles Gossalin, E. David Sherman, Gustave Gingras, and Mary Ritchuk 10-23(151-157)
— Wheelchair Adaptations and Training Periods 10-23(153-154)
— Trends in Nonlicensed Mobility Aids: Ronald Lipskin 10-22(41-52)
— VAPC Research Report (Testing) 10-25(172) 10-26(264) 10-30(174)
— VA Prosthetics Center Program for Electric Wheelchairs and Other Non-licensed Mobility Aids: Ronald Lipskin 10-22(326-336)
— Variable-Height-Powered Wheelchair for the Quadriplegic Driver: Don M. Cunningham 10-22(337-369)
— Geometric and Functional Description of Mark IV (1974) UC Powered Variable-Height Wheelchair (PRAHN) 10-22(349-363)
— History 10-22(338-347)

— Curb- and Stair-Climbing Devices 10-22(346)
— Introduction 10-22(338-342)
— Powered Wheelchairs 10-22(343-345)
— Supporting Surface 10-22(345)
— Variable-Seat-Height Wheelchairs 10-22(345-346)
— Wheelchair Transfer 10-22(347)
— The University of California. Variable-Height Wheelchair 10-22(347-349)
— Background Steps 10-22(347)
— Design Constraints for the UC Daily Activities PRAHN Wheelchair 10-22(347-349)
Wheelchairs, Recent Patents: Robert B. Bonfield 10-29(196)
Wheelchairs
— Advanced Wheelchair *see also* National Indoor-Outdoor Wheelchair
— Freewheeler Power Wheelchair (Illust.), VAPC Research Report 10-29(85-86)
— GenTel Motor-in-the-Hub Powered Wheelchair (Illust.), VAPC Research Report 10-28(108-109)
— Independence Electric Reclining Wheelchair, VAPC Research Report 10-23(235-236)
— Lakematic Powered Wheelchair, VAPC Research Report 10-23(239-240)
— LEM Power Chair (Illust.), VAPC Research Report 10-28(114-115) 10-30(126-127)
— LEVO Stand-Up Wheelchair (Illust.) 10-30(127-128)
— National Indoor-Outdoor Wheelchair (Illust.) 10-28(109-110)
— Newton Ultra Lightweight Wheelchair, VAPC Research Report 10-23(240)
— Sevier Mobile Bed Converts to Powered Wheelchair, 10-26(248-250)
— SMP Electra *see* Stainless Medical Products Electric Wheelchairs
— Stainless Medical Products Electric Wheelchairs (Illust.), VAPC Research Report 10-28(112-113)
— Sun Industries Curb-Climbing Wheelchair (Illust.), VAPC Research Report 10-28(106-107)
— Theradyne Marquis Wheelchair, VAPC Research Report 10-21(106)
— 24-Volt Everest & Jennings Electric Wheelchair, VAPC Research Report, 10-21(98-99)
— VAPC Indoor-Outdoor Electric Wheelchair, VAPC Research Report 10-23(235-236)
— Wheelchair Powered with Printed Circuit Motors, VAPC Research Report 10-23(228-229)
— *See also* Mobility Aids for the Physically Handicapped, for

Wheelchair-Like Devices. Mobility Aids for the Severely Handicapped for Advanced Chair/Van Systems
— *See also* VAPC Research Reports—Spinal Cord Injury Rehabilitation
— Wheelchairs and Accessories
Wheeled Canes for the Blind
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Wheeled Canes 10-30(55)
Whitehead, James J.
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: J.D. Malamazian, H. Lauer, and J.J. Whitehead (Central Rehabilitation Section for Visually Impaired and Blinded Veterans VA Hospital, Hines, Ill.) 10-23(337-338) 10-24(264-265) 10-25(219-221) 10-26(350-352) 10-27(187-190)
— New Title "Clinical Study of Mobility Aids for the Blind 10-26(350-352) 10-27(187-190)
— Reading and Mobility Aids for the Blind, Centrally Directed Clinical Application Program. Contractor Reports: J.D. Malamazian, L.W. Farmer, and J.J. Whitehead (VA Hospital, Hines, Ill.) 10-21(160-161)
White House Conference on Handicapped Individuals
— 5-Day Conference: ". . . And I Say to You Tonight That the Time for Discrimination Against the Handicapped . . . is Over." Notes and News 10-28(249-250)
White House Conference on Handicapped Individuals
— Calendar of Events 10-26(384)
— White House Conference on Handicapped Individuals Now Scheduled for December 1977. Notes and News 10-25(248)
Whittaker Corporation, Connecticut
— VAPC Contractor to Develop Sonic Geriatric Monitor, VAPC Contractual Development Program, VAPC Research Report 10-24(208)
Wiener, Norbert
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C.A. McLaurin 10-25(25-37)
— Introduction 10-25(25-27)
Wilch Manufacturing, Inc., Topeka, Kansas
— Reyer Lift, VAPC Research Report 10-25(153)
Wiley, J. Kenneth
— Appointed Chief of Center for Blind. Notes and News 10-24(278)
— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: K. Wiley, G. Goodrich, N.C. Darling, and R. Bennett (Western Blind Rehab. Center, VA Hospital, Palo Alto, Calif.) 10-24(267-268) 10-25(223-227) 10-26(354-356) 10-27(82-91 Report incorporated into article under "A Preliminary

Followup Study of Electronic Travel Aid Users") 10-28(232-235) H.S. Paul 10-29(171-173) 10-30(272-273)
— A Preliminary Followup Study of Electronic Travel Aid Users: Nancy C. Darling, Gregory L. Goodrich, and J. Kenneth Wiley 10-27(82-91)
Williams, Russell C.
— Chief of Blind Rehabilitation at VACO Retires. Notes and News 10-24(277-278)
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— The Long Cane 10-30(48)
Willis, David John
— Turning Bed. Recent Patents 10-30(292)
Wilson, A. Bennett Jr.
— The Role of the Committee on Prosthetics Research and Development and the Committee on Prosthetic-Orthotic Education: A.B. Wilson Jr. 10-22(478-486)
— Sensory-Aids Workshop: A.B. Wilson, Jr. 10-22(509-512)
— Ultralight Below-Knee Prosthesis. Contractor Reports: A.B. Wilson (Moss Rehabilitation Hospital, Phila., Pa.) 10-27(176-179) 10-28(218-219) 10-29(122-123) 10-30(196-197)
Wilson, Leigh A.
— Below-Knee Amputation with Immediate Postoperative Fitting of Prosthesis. Contractor Reports. W.S. Moore, A.D. Hall, and L.A. Wilson (VA Hospital, San Francisco, Calif.) 10-21(128) 10-23(300) 10-24(225 no report) 10-25(200 no report) 10-26(307) 10-27(142 no report)
Winsford Feeder
— VAPC Research Report 10-28(126-127)
Winter, D.A.
— A Voluntarily Controlled Electrohydraulic Above-Knee Prosthesis: W.R. Dyck, S. Onyshko, D.A. Hobson, D.A. Winter, and A.O. Quanbury 10-23(169-186)
Wireless Environmental Control
— VAPC Research Report 10-21(85-86)
Wireless Telemetry Systems
— Mobility Devices: Leicester W. Farmer 10-30(47-118)
— Guidelines for Design 10-30(78-80)
— *See also* In Vivo Loading of Knee Joint Replacements
Wirta, Roy
— Pattern-Recognition Arm Prosthesis — A Final Report: R. Wirta, D.R. Taylor, and F.R. Finley 10-30(8-35)
Wojcik Industries, Inc., Fallbrook, California
— Therapeutic Wheelchair Rocker, VAPC Research Report 10-25(158-159)
Wood, Alice

— Clinical Application Study of Reading and Mobility Aids for the Blind. Contractor Reports: R. Bennett, N. Darling, A. Frost, G. Goodrich, R. Ward, and A. Wood (Western Blind Rehabilitation Center, VA Hospital, Palo Alto, Calif.) 10-23(339-341)
Wood, Marjorie McGuffin
— First Recipient of Arthur Napier Magill Annual Award. Notes and News 10-26(372)
Wooldridge, C.P.
— Biofeedback — Background and Applications to Physical Rehabilitation: C.P. Wooldridge and C. McLaurin 10-25(25-37)
Woolen and Cotton Stump Socks
— VAPC Research Report 10-25(172)
— *See also* "Testing"
Workshop on Low Vision Mobility: Loyal E. Apple and Bruce B. Blasch 10-26(46-138)
— *See* entry under "Low Vision" for detailed listing
Workshop Panel Discussions (VA Conference of Prosthetics and Sensory Aids); Anthony Staros 10-22(488)
World Biomaterials Congress
— Calendar of Events 10-29(203) 10-30(301)
World Confederation for Physical Therapy
— 8th International Congress. Calendar of Events 10-24(294) 10-25(266) 10-26(386) 10-27(217)
World Conference on the Theory of Machines and Mechanisms
— 5th Conference. Calendar of Events 10-28(266) 10-29(202) 10-30(299)
World Council for the Welfare of the Blind
— 6th World Assembly. Calendar of Events 10-28(266) 10-29(202) 10-30(300)
— World Conference on the Deaf/Blind. Calendar of Events 10-24(294) 10-25(266)
World Federation of the Deaf
— 7th International Congress. Calendar of Events 10-26(386) 10-27(217)
— 7th Congress. Calendar of Events 10-21(186) 10-22(537)
— 8th Congress. Calendar of Events 10-26(386) 10-27(218) 10-28(266) 10-29(202) 10-30(299)
World Rehabilitation Fund
— Plans 4 new Overseas Prosthetic-Orthotic Workshops. Notes and News 10-27(205-206)
World Veterans Federation
— 2nd Conference on Prosthetics. Calendar of Events 10-22(537) 10-23(365) 10-24(292)
World War II
— Clinical Application Study of Externally Powered Upper-Limb

Prosthetics Systems: The VA Elbow, the VA Hand, and the VA/NU Myoelectric Hand Systems: Earl A. Lewis, Carol R. Sheredos, Tamara T. Sowell, and Vern L. Houston 10-24(51-136)
— Introduction 10-24(51-52)
Wormald-Vigilant, Ltd., Christchurch, New Zealand
— Binaural Sensory Aid for the Blind: Howard Freiberger 10-22(75-76)
— *See also* The Sonicguide
Wound Healing: Ernest M. Burgess 10-22(109-113)
Wound Healing
— Skin Blood Flow and Healing: Wesley S. Moore 10-22(105-108)
Wound Healing *see also* Postsurgical Wound Management, Immediate Postsurgical Management, *see also* Controlled Environment Chamber, etc.
Wrist-Hand Orthoses
— VAPC Powered Wrist-Hand Orthosis, VAPC Research Report 10-24(162-163)
Wrist Orthosis
— Wrist Orthosis for Management of Tremor. Contractor Reports: J.W. Gesink, M. Rosen, E. Falkenberg, and J.D. Jacobi (VA Hospital, Miami, Florida) 10-23(328)
Wren, Jack
— Knee Prosthesis. Recent Patents 10-25(257)
Wrethander, Karl Edvin Sixten
— Rehabilitating Chairs for Handicapped Persons. Recent Patents 10-21(179)

X

Xenon 133 Clearance Skin Blood Flow Measurement (Diagram) 10-22(107)
— Moore, W.S., Explanation of Procedure (brief) 10-28(2)
— *See* detailed-list entries of "Hemodynamic Evaluation of Postoperative and Preoperative Amputees", *also* "Below-Knee Amputation with Immediate Postoperative Fitting of Prosthesis", also Prosthetics Research Study, Seattle, Washington.
X-Ray Analysis
— Physical Response of SACH Feet Under Laboratory Testing: R.L. Daher 10-23(4-50)

Y

Yakobson, Yakov Savelievich
— Electrically Driven Artificial Hand for Upper Extremity Pros-

thesis. Recent Patents 10-24(285)
Yalow, Rosalyn S.
— VA Nobel Prize Winner in Medicine. Notes and News 10-28(243-244)
Young, Lamar L.
— Development of Test Procedures for Evaluation of Binaural Hearing Aids. Contractor Reports: R. Carhart, and L. Young (Northwestern University, Evanston, Ill.) 10-23(341-342) 10-24(268-269) 10-25(227-231) 10-26(356-357 Report for this period, plus Summary, appears in article under same title, 10-26(9-45)
— Development of Test Procedures for Evaluation of Binaural Hearing Aids — A Final Report: R.T. Carhart and L.L. Young 10-26(9-45)

Z

Zadina, Alfred
— Drive for an Orthosis or a Prosthesis. Recent Patents 10-30(288)
Zero-Pressure Remote Power Control
— VAPC Research Report 10-26(223)
Zero-Pressure Telephone Dialer
— VAPC Research Report 10-27(104)
Zevering, Willem
— Artificial Leg. Recent Patents 10-26(375)
Zila, Josef
— Apparatus for the Identification of Size Numbers of Right and Left Lasts. Recent Patents 10-30(287)
ZYGO Model 16 Communication Board, VAPC Research Report 10-28(101)

NOTICE TO CONTRIBUTORS

We welcome contributions to the Bulletin. To facilitate publishing please:

1. Type in double space the text, figure captions, footnotes, references, and tables on one side of letter-size, plain bond paper.

2. Leave margins of 1½ inches on the left and 1¼ inches on the right.

3. Capitalize title of paper and center. Below title, center author's name(s) with highest degree or certification. Then center position title, organization, and location (full address and zip code).

4. Number pages consecutively in the lower right-hand corner of the page in pencil. Each page must start with a new paragraph. Type preceding page short if necessary. Indent paragraphs.

5. Cite all references by number in the text and list numerically at end of paper.

6. Submit halftone photographs with good contrast on 8″ × 10″ glossy paper. Line drawings should be in India ink. Do not dent glossy photographs or art work with paper clips. All figures must be suitably protected for flat mailing.

7. Provide a caption for each figure and cite by number within the text. Type caption on separate sheet. Pencil in lightly on back of each glossy photograph the figure number, author's name, and article title. Use Arabic numbers for tables and figures.

8. Number tables and include a short title. Each table should be typed on a separate sheet of paper and must be cited within the text.

9. Obtain and send us letters of permission to reprint copyrighted written and illustrative material. When furnishing us with illustrative material, written permission from subjects in photographs should be included. Failure to do so will result in blanking out a subject's face.

10. Send us original and one copy of manuscript. Retain a third copy. Address manuscript and correspondence to:

Editor, Bulletin of Prosthetics Research
Office of Technology Transfer
Veterans Administration
252 Seventh Avenue, New York, N.Y. 10001

Acknowledgment of all manuscripts will be made as promptly as possible.

Note: Insert metric equivalents in parentheses after all measurements.